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The impact of ESG on firms' cost of equity

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Table of contents

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Citations

- *"If a business is not ethical, it will fail, perhaps not right away but eventually"* - Sir John Templeton - Philanthropist and Investor

- *"Capital will go where it is wanted, and it will stay where it is well treated"* - Walter Wriston - Former Chairman of Citibank

- "*In a changing environment, there is no greater risk than staying still*" - Jacques Chirac - Former President of the French Republic

- *"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."* - Aldo Leopold - Former American author, philosopher, scientist, ecologist, forester, conservationist, and environmentalist

- "*The time is past when humankind thought it could selfishly draw on exhaustible resources. We know now the world is not a commodity."*- François Hollande - Former President of the French Republic

- *"What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves and to one another."* - Gandhi - Former Indian activist

- "*Reducing our levels of consumption will not be a sacrifice but a bonus if we simply redefine the meaning of the word 'success."* - David Wann - Author

- *"Problems cannot be solved at the same level of awareness that created them."* - Albert Einstein - Former German mathematician and physicist

Aim of this Master' s thesis

The main objective of this Master' s thesis is to test whether the degree of (un)sustainability of a firm could be associated to a new risk factor that would explain asset returns in addition to the traditional three factors of the Fama-French asset pricing model.

More precisely, I am going to analyze if, once we take into account market, size and value risks when pricing stocks, there is indeed a statistically significant risk premium associated to an extra ESG[1] factor.

The core hypothesis we will test can therefore be summarized as:

"The risk exposure to an ESG-related factor added to the classical Fama-French model is significantly different from zero".

Globally, it is generally assumed that shareholders are willing to accept lower returns if companies have good sustainable scores [e.g., Sharfman and Fernando (2008); El Ghoul et al (2011); Chava (2011); Reverte (2011); Dhaliwal et al (2011); and Barth et al (2013)]. Indeed, in that case, firms would be considered by these persons as more suited to future development prospects and they would therefore be considered as less risky for the coming years [e.g., Sharfman and Fernando (2008); Lee and Faff (2009); Oikonomou et al (2012); and Sassen et al (2016)]. In the risk-return framework, the notion that sustainable leaders are less risky investments than laggards implies that investors demand a lower return on sustainable firms' stocks (Guenster et al (2011)).

To verify the statistical viability of the assumption at the heart of this Master' s thesis, I will proceed step by step by first making peripheral analyses and then by explicitly creating an ESG factor. Such that, we will be able to largely browse the impact of firms' ESG commitment on their cost of equity.

More precisely, I will first investigate the potential correlation existing between returns and ESG criteria. This will give us a first insight into the intuition that companies with poor ESG performance would be associated with higher returns.

Then, I will investigate the potential effect of sustainability on market-risk betas extracting either from the CAPM or the Fama-French three-factor model. This step will highlight the potential impact ESG scores have on the non-diversifiable and oldest risk factor; that is, the

[1] Environmental, Social, Governance.

market one. It could in fact be assumed that ESG criteria have an influence on the famous *"Beta"* [e.g., Ashbaugh et al (2004); Derwall and Verwijmeren (2007); Salama et al (2011) Oikonomou et al (2012); and Albuquerque et al (2018)]. In that case, sustainability would have the potential to change the relationship existing between returns and renowned systematic risk factor.

Next, I will analyze the impact of sustainability on risk-adjusted returns [e.g., Gompers et al (2003); Derwall et al (2005); Derwall et al (2011); Eccles et al (2013); and Edmans et al (2014)] using again the two best known and used pricing models. If ESG criteria prove to have an impact on the alphas, it might especially suggest that there is a missing sustainable risk factor in the aforementioned asset pricing models (Lee and Faff (2009)).

Finally, I am going to build an ESG factor defined as the difference in returns between firms with the worst ESG scores less firms with the best ESG scores and to add it to the three common risk factors of Fama and French [e.g., Koch and Bassen (2012); Girerd-Potin et al (2014); Jin (2017); Hübel and Scholz (2019); and Görgen et al (2019)]. If our initial intuition is corroborated, we expect a positive and statistically significant risk premium associated to this new factor for low ESG companies [e.g., Ashbaugh et al (2004); Girerd-Potin et al (2014); and Jin (2017)].

Regarding the thread of this Master' s thesis, I will first introduce the concept of Responsible Investment (RI). Then, we will move to the literature review mainly outlining the links between firms' cost of capital/performance and sustainability. Afterward, we will turn to a brief description of data and pricing models we are going to use latter on when performing statistical and econometric manipulations. Next, I will expose my research methodology and we will discuss findings. Finally, I will highlight the conclusion inherent in this Master 's thesis.

Background

Sustainability has without a doubt been one of the most significant trends in financial markets for decades. Whether in the form of investors' desire for responsible investing (RI), or corporate management's focus on corporate social responsibility (CSR), the content, focusing on sustainability and ESG (environmental, social and governance) issues, is the same.

The growth of the UN Global Compact[2], the United Nations backed Principles for Responsible Investment (UN PRI)[3], the Global Reporting Initiative (GRI)[4], the Carbon Disclosure Project (CDP)[5], the Sustainability Accounting Standards Board (SASB)[6], the American[7] and European[8] SRI markets and the fact that sustainable investing assets in the five[9] major markets stood at $30.7 trillion at the start of 2018[10], all bear strong testament to sustainability concerns.

What is precisely responsible investment?

Responsible investment is broadly defined as an investment process that involves identifying firms with high CSR profiles where the latter are evaluated on the basis of environmental, social and corporate governance criteria.

RI is therefore an approach to investing that explicitly acknowledges the relevance to the investor of ESG factors, and of the long-term health and stability of the market as a whole. It admits that the generation of long-term sustainable returns is dependent on stable, well-functioning and well-governed social, environmental and economic systems.[11]

Responsible investment can be differentiated from conventional approaches to investment in two main ways. The first is the timeframe; the goal is the creation of long-term investment returns that are sustainable rather than just short-term returns. The second is that responsible investment requires that investors pay attention to the wider contextual factors, including the stability and health of economic and environmental systems and the evolving values and expectations of the firms of which they are part.

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[2] For more information on the UN Global Compact, see: www.unglobalcompact.org and/or consult Appendix 1.
[3] Background information on the United Nations backed Principles for Responsible Investment (UN PRI), see: www.unpri.org and/or consult Appendix 1.
[4] Consult Appendix 1 and see Global Reporting Initiative's website for further information: www.gri.org.
[5] For more information on Carbon Disclosure Project, see: www.cdp.net and/or consult Appendix 1.
[6] Know more about SASB on www.sasb.org and/or consult Appendix 1.
[7] US SIF (www.ussif.org).
[8] Eurosif (more information available in Appendix 1 and on www.eurosif.org).
[9] Europe, United States, Japan, Canada and Australia/New Zealand.
[10] Global Sustainable Investment Alliance (GSIA) (2018).
[11] Definition extracted and then adapted thanks to a 2016 UN PRI rapport available on: https://www.unpri.org/download?ac=1398.

In short, it can be said that responsible investment is an investment strategy which attempts to generate both financial and sustainable value.
It consists of a set of investment approaches that integrate environmental, social and governance (ESG) as well as ethical issues into financial analysis and decision-making.

What are the main different responsible investment strategies?

Responsible investment encompasses a number of investment approaches, but it can be categorized into two broad strategies[12].

One is ESG incorporation, which considers environmental, community, other societal or corporate governance (ESG) criteria in investment analysis and portfolio construction.
ESG incorporation can be accomplished in various ways:

- **Positive screening**
  - It implies the active inclusion of corporations within an investment universe because of the social or environmental benefits of their products and/or processes.
  - For example, all water firms may be included in a universe on account of the social benefits of clean water supply and the environmental benefits of wastewater treatment.
- **Best-in-class**
  - It is a comparative investment style that involves investing only in companies that lead their peer groups in respect of environmental and social performance.
  - Under this approach, solely a proportion of water companies may be included within an investment universe as only a proportion can be *"the best"*.
- **Ethical negative screening**[13]
  - This is where a company's activities are compared against a list of negative practices.
    If they are involved in too many, they will not be considered acceptable candidates for ethical investment.
  - It refers so to the screening of companies on moral, ethical or religious grounds

[12] Section mainly developed thanks to US SIF's website: https://www.ussif.org/misperceptions and to the SRI CONNECT's site: www.sri-coonect.com. Some information have also been collected on: http://www.nylinvestments.com/public_files/SRI/pdf/Candriam-GSIA-Definitions.pdf.
[13] Definition developed thanks to THE GUARDIAN's site: https://www.theguardian.com/money/2001/nov/11/ethicalmoney.

such as lending at interest, contraception, or animal testing.

- **Environmental/social negative screening**
    - It relates to the removal of firms or sectors from an investment universe for falling short of any absolute environmental, social or economic standards.
    - Such screening may remove corporations exposed to activities such as nuclear power, pornography or tobacco manufacture.
    - **Norms-based screening** is a sub-category of environmental/social negative screening. It refers to the screening of investments according to their compliance with international standards and norms[14] such as the UN Global Compact, the Kyoto Protocol, the UN Declaration of Human Rights etc.
- **ESG integration**
    - It refers to the systematic and explicit inclusion by asset managers of ESG factors into financial analysis.
- **Impact investing**
    - Impact investments are investments realized with the intention to generate positive, measurable social and environmental impact alongside a financial return.[15]
    - For instance, Revolution Foods intends to alter the system of childhood nutrition in the United States by providing healthy, nutritious school lunches in public and charter schools.
    - Another example is Springboard Education which provides after-school educational enrichment programs to 3,000 students at 50 public and charter schools in 11 states in the United States.
    - Finally, let us take the example of BrightPower which provides comprehensive energy efficiency audits and heating and lighting retrofits for multi-tenant affordable housing in the New York metropolitan area.[16]

[14] Definition refines thanks to the following EUROSIF's website: www.eurosif.org/responsible-investment-strategies/.
[15] See namely the GIIN's site (https://thegiin.org/impact-investing/need-to-know/) for more information.
[16] Examples extracted from a paper of the Harvard Business Review (https://hbr.org/2016/01/making-sense-of-the-many-kinds-of-impact-investing).

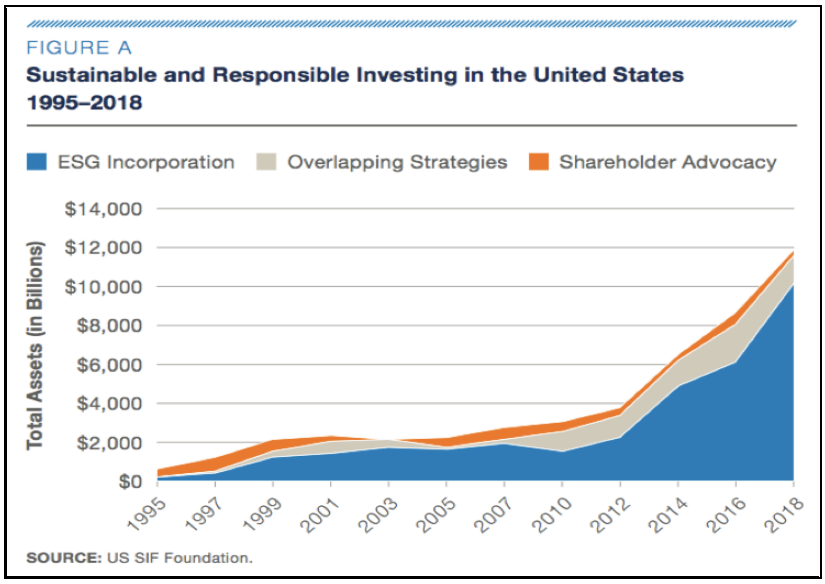
- **Sustainability-themed investing**
    - The selection of assets specifically related to sustainability in single-or multi-themed funds.
    - Thematic funds focus on corporations that are active in sectors that favor the sustainable development of renewable energies, water, medicine, or more generally, deal with climate change, energy efficiency, health or the aging population.
- **Community investing**
    - It involves the provision of capital and financial services to communities that are underserved by traditional financial services and particularly to low-income individuals, small businesses and community services such as childcare, affordable housing, and healthcare.

Shareowner engagement is the other principal approach to RI.
It involves the actions sustainable investors take as asset owners to communicate to the managements of portfolio companies their concerns about the companies' ESG policies and to ask management to study these issues and make improvements.
Investors can directly communicate with corporate management or through investor networks.
For owners of shares in publicly traded firms, shareholder engagement can take the form of filing or co-filing shareholder resolutions on ESG issues and conscientiously voting their shares on ESG issues that are raised at the companies' annual meetings.

According to the *US SIF Foundation's 2016 report*[17] *on US Sustainable, Responsible and Impact Investing Trends*[18], the total US-domiciled assets under management using RI strategies grew from $6.57 trillion at the start of 2014 to $8.72 trillion at the start of 2016, an increase of 33 percent, as illustrated in Figure A.
In 2016, these assets accounted for more than one out of every five dollars under professional management in the United States.

[17] Available on the following link: https://www.ussif.org/files/SIF_Trends_16_Executive_Summary(1).pdf.
[18] The Trends Report - first compiled in 1995 - is the most comprehensive study of sustainable and impact investing in the United States.

Figure A : Evolution of the two strategies linked to RI between 1995 and 2018[19]



Indeed, the assets engaged in sustainable, responsible and impact investing practices at the start of 2016 represented nearly 22 percent of the $40.3 trillion in total assets under management tracked by Cerulli Associates[20].

By looking at the *US SIF Foundation's 2018 Report*[21] *on US Sustainable, Responsible and Impact Investing Trends*, sustainable, responsible and impact investing assets accounted for $12.0 trillion - or one in four dollars - of the $46.6 trillion in total assets under professional management in the United States at that time.

This represents a 38 percent increase over 2016.

Since the first report when assets totaled just $639 billion to 2018, the sustainable and responsible investing industry has grown 18-fold.

A quick overview of the evolution of responsible investment[22]

Ethical investing dates back to 1500. This included values-based investors who wished to screen out specific investments that were not compatible with their missions and goals. Those exclusionary screens often included so-called *"sin"* stocks like alcohol, tobacco, gun makers or casinos. Here, investors were prepared to give up on risk-adjusted returns in order to align

[19] Source: US SIF Foundation.
[20] Cerulli Associates is a research firm that specializes in worldwide asset management and distribution analytics and guidance.
[21] Available on the following link:
https://www.ussif.org/files/US%20SIF%20Trends%20Report%202018%20Release.pdf.
[22] For deeper information see the Deutsche Bank study from 2012 available on www.db.com/cr/en/docs/Sustainable_Investing_2012.pdf.

their investments with their ethical values.

Then, we saw the emergence of a second wave of positive screening. This approach incorporates ESG themes into investment decisions by way of tilting a portfolio toward firms with the ESG attributes investors wanted exposure to. The goal is to deploy capital to create and reinforce positive impact and, in most cases, this also implies the aim of achieving market-like returns.

The third and most recent evolution involves harnessing ESG information and integrating it into the investment process and risk and framework to improve the investment outcomes - either in terms of generating incremental return or better managing risk. Investors' desire for improved risk/return outcomes drove focus to this type of investing.

What does ESG stand for?

This term is an international acronym used by the financial community to designate the Environmental, Social and Governance (ESG) criteria which are usually the three pillars of the extra-financial analysis.

ESG criteria are in fact analytical criteria used to assess the consideration of sustainable development and long-term issues in corporate strategy.

The environmental criterion looks at how a firm performs as a steward of nature.

The social criterion examines how a corporation manages relationships with its employees, suppliers, customers and the communities where it operates.

The third and last criterion, which is linked to governance, deals with a company's leadership, executive pay, audits, internal controls and shareholder rights.

Environmental, social and governance criteria are essentially used as a framework by responsible investors to screen investments or assess risks in investment decision-making.

What exactly does each of the three criteria refer to[23]?

After having given a global and formal definition of what ESG criteria are, it is now time to analyze more specifically each criterion and, simultaneously, to highlight some specific examples of how companies can act on those factors.

❖ Environmental factors

Environmental factors are about a company's impact on the environment.
They are based on the premise that business activities have the potential to create environmental risks for ecosystems, water, air, land and human health.
The respect of the E pillar encompasses the following acts in particular:

- Using energy efficiently;
- Using renewable energies that emit fewer GHG[24], are less polluting, and contribute less to climate change;
- Managing waste responsibly and so, avoiding inappropriate disposal or handling of waste;
- Having responsible practices across the value chain such as no deforestation policies, no contamination of groundwater, forests, rivers, or seas policies or even animal welfare policies;
- Disclosing information on all environmental policies.

Environmental positive outcomes include avoiding or minimizing environmental liabilities, lowering costs and increasing profitability through energy and other efficiencies, and reducing regulatory, litigation and reputational risk.

❖ Social factors

Social factors have to do with the way businesses treat and value people.
In other words, it is about the impact that companies can have on their employees and on society.
What do have companies to put in place to respect the S pillar?

[23] For more information on ESG definition, principles and examples, see namely the E-CSR's site (https://e-csr.net/definitions/esg-what-is-it-definition-principles-and-examples/) and SustainabilityHQ's website. (https://www.sustainabilityhq.com/esg-matters/esg-factors-master-lists-categories/).
[24] Greenhouse gas.

- Diversity and inclusion policies to ensure no social discrimination[25];
- No discrimination in employment (which is social discrimination against employees);
- Safe and healthy working conditions for employees;
- Labor standards across supply chains that guarantee fair wages and human rights protection;
- Good relations with local communities who give social license for companies to operate;
- A commitment to ensure product safety and data protection;
- A mission having the potential to create social opportunities (access to capital, healthcare, the internet and/or nutritious food)[26];
- A commitment to ensure no child labor (which also includes child prostitution, pornography, and trafficking) as well as no forced labor (such as bonded labor, prison labor, exploitative practices, restrictions on freedom of movement, or withholding of wages);
- No local participation issue which arises when local communities or individuals are not consulted about the firm's activities or when they do not benefit appropriately, and when critics are silenced by unethical tactics;
- Companies also need to report information on what they're doing in this area.

Social positive outcomes under this pillar include, for instance, increasing productivity and morale, reducing turnover and absenteeism and improving brand loyalty.

❖ Governance factors

Governance factors focus on corporate policies and how companies are governed.
It is about making the responsibilities, rights, and expectations of stakeholders clear so that interests are met and a consensus on a company's long-term strategy is achieved.
Examples of specific factors under which governance is analyzed can be:

- Tax evasion, such as not paying taxes by illegal means, but also the use of tax havens;
- Tax optimization, which is a non-illegal practices of minimizing tax liability;
- Fraud, which corresponds to intentional deception made for personal gain or damage to

[25] Social discrimination refers to treating people differently because of certain characteristics, such as gender, racial, ethnic, or religious.
[26] For instance, companies that develop medical treatments for undertreated conditions or for diseases that are prevalent in developing countries could score well in this category.

another individual, including counterfeiting, false advertising, misleading investors, or stock price manipulations;

- Corporate risk management;
- Executive compensation issues such as excessive salaries or bonuses;
- Donations and political lobbying;
- Corruption, bribery, extortion and money laundering;
- Board structure and brand independence;
- Protection of shareholder rights and interests;
- Voting procedures;
- Anti-competitive practices, which are practices that prevent, reduce, or manipulate competition in markets, such as bid rigging, dumping, exclusive dealing, or price fixing;
- Disclosure of information on these topics.

The effects of these policies can go from aligning shareholders' interests with management to avoiding unpleasant financial surprises and having a better social acceptance as a result of wealth being fairly distributed.

By which providers are ESG criteria established?[27]

Over time, it has become increasingly critical for responsible investment professionals to understand the ESG profile behind the assets they are managing. Consequently, the access to relevant, consistent, comparable, balanced and reliable ESG information has become a prerequisite for asset managers to take the right investment decisions. The financial services market has responded to this need by producing specific ESG ratings, rankings and indices. More and more international and domestic public (and many private) companies are now being evaluated and rated on their ESG performance by various third-party providers of reports and ratings. Importantly, a 2016 report provided by SICM[28] has highlighted that, next after public information, third party research was the other principal way professional investors get ESG data. There are currently numerous ESG data providers. Some well-known third party ESG report and ratings providers include:

[27] For additional information see: https://corpgov.law.harvard.edu/2017/07/27/esg-reports-and-ratings-what-they-are-why-they-matter/.
[28] Sustainable Insight Capital Management. Report available on: https://www.sicm.com/docs/who-rates.pdf.

- **Bloomberg**[29] which, in 2009, launched Bloomberg ESG Data Service;
- **Corporate Knights**[30] which publishes an annual index of the Global 100 most sustainable corporations in the world in its Corporate Knights magazine;
- **S&P Dow Jones Indices**[31], one of the world's leading index providers, and RobecoSAM, the investment specialist that has focused exclusively on Sustainability Investing for over 24 years, publish each year the results of the Dow Jones Sustainability Indices (DJSI) review;
- **Institutional Shareholder Services**[32], which launched the ESG Index Solutions in March 2019;
- **MSCI ESG Research**[33], launched in 2010, one of the largest independent providers of ESG ratings;
- **RepRisk**[34] which was founded in 1998. With over a decade of experience serving the world's largest financial institutions and corporates, RepRisk is a pioneer in ESG and business conduct due diligence data;
- **Sustainalytics**[35], an independent ESG and corporate governance research, ratings and analysis firm supporting investors around the world with the development and implementation of responsible investment strategies;
- **Thomson Reuters**[36], whose origins go back to 1799, a Canada-UK news agency and a professional, financial and legal publishing company.

[29] More information on: www.bloomberg.com/bsustainable.
[30] More information on: www.corporateknights.com.
[31] More information on: eu.spindices.com.
[32] More information on: www.issgovernance.com.
[33] More information on: www.msci.com/products/esg.
[34] More information on: www.reprisk.com.
[35] More information on: www.sustainalytics.com.
[36] More information on: www.thomsonreuters.com.

What is fueling the growth of responsible investment?

The rising interest in responsible investment is being driven by a number of factors. Those can be summarized as follows:

- **High demand for life values**

While this may be difficult to measure, it is believed that we live in an increasingly interconnected and interdependent world. Our lives and happiness are increasingly connected to the well-being of others. As our communities prosper, so do we.

To that respect, it has been shown there is a spiritual yearning on the part of a large and growing segment of the population to integrate personal values into all aspects of life, including finance and investing.

In 1999, for instance, in the USA, over 50 million people identified themselves as *"Cultural Creatives"*[37] interested in supporting sustainable companies in all aspects of their lives.

There is also the Millennial Generation[38], also known as Generation Y, viewing finance and investment as powerful tools for changing the world. The Millennials[39] also view ESG integration as an essential component of their own investments. Equally, the increase in female participation in the labor market has further driven sustainable pension choices. Both of these groups – women and Millennials – tend to invest in order to make a clear and measurable positive impact on society, not just to generate profit. Consequently, sustainability awareness is having major knock-on effects for both investors and asset managers alike.

- **Corporate scandals**[40]

Over time, corporate governance has attracted a great deal of public interest due to its apparent importance for the economic health of corporations and society in general.

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[37] *"Cultural creatives"* are a broad socio-cultural group that is at the forefront of social change and has been highlighted by American sociologist Paul Ray and American psychologist Sherry Anderson. *"Cultural creatives"* bring together individuals who share a global and *"integral"* vision of the world and share a set of values. The individuals making up this socio-cultural group seek, among other things, to encourage low dependence on industrialized consumption patterns, to seek to promote personal and spiritual development, to put the human person back at the heart of society, to refuse environmental degradation, especially those resulting from the exploitation of natural resources and to seek new solutions to personal or social problems.
Source used: culturalcreatives.org.

[38] See: https://www.europeanceo.com/finance/millennials-and-women-key-drivers-of-socially-responsible-investment/.

[39] See: https://www.morganstanley.com/pub/content/dam/msdotcom/ideas/sustainable-signals/pdf/Sustainable_Signals_Whitepaper.pdf.

[40] See the following paper: *"Corporate Governance: An Ethical Perspective"* realized by Surendra Arjoon and available on https://sta.uwi.edu/conferences/financeconference/Conference%20Papers/Session%205/Corporate%20Governance%20-%20An%20Ethical%20Perspective.pdf.

The headlines of the previous years in particular portrayed a sad story of corporate ethics (or lack thereof). For example, the fall of Enron in 2001 or the bankruptcy of WorldCom in 2002 drew attention to governance *"failures"*.

In addition to that, the financial crisis of 2007-2008 acted as a wake-up call to many, showcasing the flaws and short-termism of the financial sector.

These multiple facts have clearly undermined investors' confidence.

Most of the investors are now attracted to an investment process based on research that goes deeper into corporate policies.

- **Environmental crisis**[41]

The main environmental challenge in today's world is to keep the planet livable for current and future generations. There is increasing evidence that human activities are affecting the Earth system, threatening the planet's future livability. Pollution, climate change, biodiversity loss, overfishing of the seas, CO2 emissions, overconsumption, destruction of the forests, rise of the see level, dietary choices and habits are so many points people, including investors, have to tackle in order to avoid a climate catastrophe in the coming years.

With this respect, the environmental impact of businesses has also been the subject of public debates ever since corporate negligence repeatedly resulted in incidents with immense damage caused to the environment and human health. As an illustration, we can highlight the following incidents: the Seveso incident in 1976; the Bhopal incident in 1984; the Chernobyl nuclear disaster in 1986 or even the Exxon Valdez spill in 1989. To better evaluate their exposure to environmental risks, investors increasingly demand that firms assess and disclose their relative risk position to climate change.

- **Social shortcomings**[42]

Mass production in a competitive economic system has led up to long working hours, underpayment and child labor, first in the developed world and later relocated to the developing world. Human rights provide the basic social foundation for all people to lead lives of dignity and opportunity. Human rights norms assert the fundamental moral claim each human has to life's essentials, such as water, food, healthcare, education, freedom of

[41] For detailed information see: https://www.un.org/sustainabledevelopment/sustainable-development-goals/.
[42] Information also found on the site described in footnote 41.

expression, political participation and personal security.

Knowing that globally, one in nine people in the world today is undernourished, that 783 million people live below the international poverty line of US$1.90 a day or even that women and girls continue to suffer discrimination and violence in every part of the world is sufficient to understand the multiple government, citizen and corporate actions related to societal issues.

- **Choice**

At the end of 2017, there were 234 mutual funds and exchange traded funds available for socially conscious investors[43].That is more than the double of the number of funds offered in 2012. This allows a broad range of choices to meet almost all investment needs and it allows investors to diversify to reduce their market risk.

- **More and better access to information[44]**

Investors are more informed and educated today on ESG matters. Research companies provide higher quality information than ever before, and better-informed investors are deemed to be more aware and responsible. Though there is no standardized framework for evaluating or methodology for measuring RI data, initiatives are advancing through organizations such the Sustainability Accounting Standards Board (SASB) and the Global Reporting Initiative (GRI) to establish industry standards on RI reporting and disclosure, to enable investors to make better informed investment decisions.

- **Pressure from competitors[45]**

Competitors are seeking to differentiate themselves by offering responsible investment services as a competitive advantage. In 2013, Accenture conducted a survey[46] of 1,000 CEOs in 103 countries and 27 industries. They found that 80% of CEOs view sustainability as a means to gain competitive advantages relative to their peers. In addition to helping companies differentiate themselves in an already crowded marketplace, social responsibility also inspires innovation within corporations, thereby developing longer-term immunity and business

[43] See: https://eu.usatoday.com/story/money/2018/05/11/millennials-socially-responsible-investing/580434002/.
[44] Argument developed thanks to the following site: https://www.crossmarkglobal.com/wp-content/uploads/The-Evolution-of-Responsible-Investing-2017.pdf.
[45] https://hbr.org/2006/12/strategy-and-society-the-link-between-competitive-advantage-and-corporate-social-responsibility.
[46] See the UN Global Compact-Accenture CEO Study on Sustainability 2013.

sustainability.

- **Reputational risk**

The value-destroying reputational risk from issues such as climate change, pollution, working conditions, employee diversity, corruption and aggressive tax strategies in a world of globalization and social media is a big threat to the good name or standing of a business or entity. Firms need to be socially responsible and environmentally conscious to avoid or minimize reputational risk[47].

- **Growing commitment to UNPRI / PRI**

As the implementation of responsible investing has increased, so has the number of signatories to the UN Principles for Responsible Investing (PRI). Between 2006 and 2018, the number of signatories worldwide grew from 90 to 2,221[48], suggesting investor interest has become much more significant. PRI works with a signatory network of international asset owners, investment managers and service providers to put a set of six voluntary principles into practice. Members publicly report their responsible investment activity for these principles, and in doing so, openly demonstrate commitment and promote the adoption and implementation by others. Investors are creating integration strategies in order to *"walk the talk"* to these six commitments.

- **Political pressure[49]**

From a policy perspective, there is a desire to harness the financial weight of institutional investors to support global accords such as the Paris Agreement and the Sustainable Development Goals.[50] The G20 Leaders' Communiqué referenced the importance of green finance for the first time following the Hangzhou Summit of September 2016.

- **The financial impact of neglecting sustainability and ESG issues from a legal and regulatory point of view**

Clark et al (2015) show that a neglect of environmental, social and governance (ESG) issues

[47] See namely https://www.investopedia.com/terms/r/reputational-risk.asp.
[48] Search made on this website: https://www.unpri.org/signatories.
[49] See: http://www.oecd.org/finance/Investment-Governance-Integration-ESG-Factors.pdf.
[50] The Paris Agreement is a global climate treaty negotiated at COP21 that aims to hold further global warming below two degrees Celsius. The 17 Global Sustainable Development Goals set out economic, social and environmental ambitions for UN member states.

led to numerous and sometimes very large[51] corporate fines and settlements. They show that the sectors which have been most affected are financial, pharmaceutical, energy, technology and automobile companies.

- **From short to long term firms' perspective**

For investors, the framework of their investment portfolio is typically set by a peer group or index benchmark. This pattern has a number of negative impacts on investment markets, especially in driving herding and short-term thinking. While long-term investors would allow firms to develop sustainable development strategies that are connected with the real needs of their business, money managers typically pursue a short-term perspective, as they buy and sell at today's market price. Managers tend so to make decisions that increase short term profits at the expense of long-term shareholder value (Benabou and Tirole (2010)). As an example, a company may be able to reduce costs temporarily by relaxing safety standards at the workplace or reducing expenditures for environmentally friendly technologies and processes. Such actions may, however, increase the risk of future lawsuits, contingent environmental liabilities, consumer boycotts, etc. (Heal (2005)). In order to avoid the risk of disruption on company performance, investment returns and market behavior, some asset owners adapt a longer-term investment approach considering ESG factors. As an illustration, Unilever announced a few years ago that the company would stop giving quarterly earnings guidance so that they could focus on the development of a new and more sustainable business model. As a result, the firm signaled to the market the types of investors it wants to own its shares.

- **Performance and cost of capital**

The last factor (but not the least) explaining the success of SRI is the increasingly high number of published studies focusing on the link between ESG criteria and companies' cost of capital and performance.

This argument is naturally at the heart of my Master' s thesis and will represent the essence of the literature review.

[51] For example, the Bank of America paid 16,650 USD MN in 2014 due to financial fraud leading up to and during the financial crisis. Another example is those of Anadarko, in the sector of energy, which paid 5,150 USD MN in 2014 because of fraudulent conveyance designed to evade environmental liabilities.

How can finance concretely contribute to sustainable development?

Finance has usually been considered as an obstacle to a better world.
By using finance as a means to achieve environmental, social and governance goals, we can however divert the planet and its economy from its current path to a world that is sustainable for all.

In a nutshell, the key role of the financial system is to allocate funding to its most productive use. Finance can so play a leading role in allocating investment to sustainable firms and projects and thus especially accelerate the transition to a low carbon and more circular economy[52]. In this allocation role, finance can also assist in making strategic decisions on the trade-offs between sustainable goals.
Further, investors can exert influence on the companies in which they invest. In this way, long-term investors can steer firms towards sustainable business practices.
Finally, finance is good at pricing risk for valuation purposes and can thus especially help deal with the inherent uncertainty about environmental issues, such as the impact of carbon emissions on climate change.

[52] A circular economy is an economic system aimed at minimizing waste and making the most of resources.

Literature review

In this part, I have tried to investigate as widely as possible, the potential relations existing between sustainability and firms/funds' performance as well as the links embracing the cost of capital and sustainable corporations' behavior.
This will allow us to have an in-depth understanding of the increasingly prominent literature linked to sustainability.

We will first review some papers aiming at achieving a conclusion relative to the impact of sustainability and fund performance. Although is it not the core of this Master' s thesis, so many papers have been written on that subject that is what not possible to elude the question. I therefore decided to provide an overview of some of the most related papers even though we do not plan to analyze them in detail.
Then, we will turn to a section dedicated to the relation existing between sustainability and firms' cost of capital. We will there investigate both equity and debt costs. The latter will be briefly discussed while the former, being core to this Master' s thesis, will require more attention. Notably, papers investigating the link between sustainability and the cost of equity capital justify the first peripheral analysis we made later on when investing the impact of ESG on market-betas. Most importantly, and as suggested by the hypothesis inherent in our study, this section also raises the question whether ESG firms' profiles do influence the cost of equity when incorporating sustainable risk factors in traditional asset pricing models.
Next, we will turn to the extremely discussed potential impact of sustainability on companies' performance. This section is quite large simply because the majority of scientific articles are interested in the above question. There, we will focus on both accounting and market-based performance indicators. This last section justifies our second peripheral analysis, that is, the impact of sustainability on risk-adjusted returns.

Sustainability and fund performance

The empirical research regarding the performance of (un)ethical funds is quite unanimous. Most papers indeed conclude that there is no performance' difference between sustainable and unsustainable funds.

Empirical papers have sometimes reported mixed evidence as to the existence of a statistically significant difference in performance between sustainable and conventional funds in U.S. markets. For instance, Gil-Bazo et al (2010) affirm that SRI funds had better performance than conventional funds, but this result only holds if SRI funds are run by management companies specialized in SRI. Funds run by companies not specialized in SRI appear to underperform conventional funds. Another example is Nofsinger and Varma (2014) who found, for their part, that sustainable funds outperform their conventional peers during times of crisis and underperform at other times.

Nevertheless, most of the studies on U.S. mutual funds report no statistical difference in the performance between sustainable and conventional funds [e.g., Hamilton et al (1993); Statman (2000); Bello (2005); and Dolvin et al (2017)].

Interestingly, in a paper which focus on Canada instead of the USA, Bauer et al (2007) reached the conclusion that *"Canadian investors can allocate their money to ethical mutual funds without experiencing a financial penalty vis-à-vis conventional mutual funds"*. As a whole, their results largely corroborate previous research on ethical mutual fund performance. Investing in sustainable mutual funds does not lead to returns that are significantly different from those delivered by conventional mutual funds. Schröder (2004) analyzed for his part US funds as well as German and Swiss funds. He reached the conclusion that *"socially screened assets seem to have no clear disadvantage concerning their performance compared to conventional assets"*. Bauer et al (2005) used them an international database containing German, UK and US ethical mutual funds. They found no evidence of significant differences in risk-adjusted returns between ethical and conventional funds. Another famous paper in such context is the one of Renneboog et al (2008) who analyzed the performance of SRI funds across the world. They found that SRI funds in the US, the UK, and in many continental European and Asia-Pacific countries underperform their domestic benchmarks. However, with the exception of few countries such as Japan, France and Sweden, the risk-adjusted returns of SRI funds are not

statistically different from the performance of conventional funds. Kreander et al (2005) focused themselves on the performance of European funds from four countries. Their results also suggest that there is no difference between ethical and non-ethical funds according to the performance measures employed in that paper.

Interestingly, in 2012, Rathner conducted a meta-analysis of 25 studies based on the performance of SRI funds relative to conventional funds. He put in light that almost 75% of the performance comparisons (SRI with conventional funds) do not find any significant performance difference. A significant out- and underperformance is virtually found to the same degree.

As a whole, we observe that most of the studies of socially responsible funds do not find significant differences in performance between those that follow a socially responsible investment strategy and those that do not.

Sustainability and the cost of capital

Here, I will first review the effects of sustainability on the cost of capital.

A firm's cost of capital is an important determinant of its valuation for two reasons. Firstly, the cost of capital is the expected rate of return demanded by a firm's investors for investing in the firm. The higher the rate of return demanded by a firm's investors for the capital they provide to the company, the more costly it is for a firm to finance itself. As capital is a basic input that the firm receives, the more costly this input is, the less likely the firm is to make a profit regardless of its level of revenues. Secondly, the cost of capital is the rate that investors use to discount a firm's future cash flows. The higher the cost of capital, the lower the present value of the company's future cash flows. Consequently, all else being equal, corporations with a lower cost of capital will be more highly valued than those with a higher cost of capital and they will therefore be more attractive to investors. Investors determine a firm's cost of capital by evaluating the riskiness of its cash flows relative to other investment opportunities that are available to them. Broadly speaking, companies are financed through either debt or equity capital. Debt capital can come from private sources[53] or from public sources[54]. In either case, the cost of debt is the applicable interest rate. The cost of equity is the return investors in the firm's shares expect as reflected in the stock price they are willing to pay relative to future expected cash flows.

The setting up of particular ESG/CSR policies has directly quantifiable effects on companies. It has been shown in the literature that a firm's costs of financing are directly affected by the firm's quality of its CSR policies, its social policies, its environmental management practices and its corporate governance structures that are in place.

The literature on ESG/CSR issues is extensive, but far from conclusive. There is however on point that is generally agreed on: the positive effects of ESG/CSR on the cost of capital. Firms with higher ESG/CSR scores tend to be able to borrow more cheaply, have higher credit rankings and lower cost of capital.

Let us first focus on the link between sustainability and the cost of debt and then, let us turn to the analysis of the relationship between sustainability and the cost of equity.

[53] (e.g., banks).
[54] (The debt markets).

Sustainability and the cost of debt

Debt is the primary means of raising long-term capital in the USA. Factors which have an impact on the price that debt holders charge the borrowers are therefore of primary importance. In this section, we will briefly explore some of the main papers aiming at exploring the link between the governance, environmental or social criteria and the cost of debt.

Academic literature has deeply investigated the effects of corporate governance on the cost of debt. Most of the papers reach the conclusion that good corporate governance leads to reduced borrowing costs.

It has been documented that certain governance measures have a significant impact on a firm's cost of debt, for example, the degree of institutional investor ownership, the proportion of outside directors on the board, the disclosure quality, and the existence of antitakeover measures[55]. Researchers nearly unanimously show that good corporate governance with respect to the aforementioned measures significantly decreases a firm's cost of debt. Bhojraj and Sengupta (2003) are of the first to investigate the potential link existing between corporate governance mechanisms and bond ratings and yields. Especially, they examined the effect of two main corporate governance mechanisms on bond ratings and yields: institutional ownership and the percentage of outside directors on corporate boards. Their results indicate that firms with a higher percentage of outside directors on the board and with greater institutional ownership enjoy lower bond yields and higher ratings on their new debt issues. Those results allude to a risk reduction role of shareholder governance mechanisms which are valued by bondholders but most likely not by shareholders. Likewise, Klock et al (2005) investigated the relation between anti-takeover provisions (as measured by the well-known GIM-index constructed by Gompers et al (2003)) and the cost of debt. They discovered that the cost of debt of firms with the strongest management rights (strongest anti-takeover provisions) was much lower than the cost of debt for firms with the strongest shareholder rights (weakest anti-takeover provisions). Their result suggests so that antitakeover governance provisions, although not beneficial to stockholders, are viewed favorably in the bond market. Ashbaugh-Skaife et al (2006) reached similar results with respect to the link

[55] Anti-takeover measures are actions taken on a continual or sporadic basis by a firm's management in order to prevent or dissuade unwanted takeovers.

between credit ratings and antitakeover provisions. They showed that the number of anti-takeover provisions is positively related to bond ratings, implying lower bond yields for companies which are protected from the market for corporate control. They also shed in light that the higher the percentage of shares held by institutional investors, the higher the bond ratings. However, their results also highlight that the number of outside blockholders is negatively and significantly related to bond ratings.

A bit latter, Cremers et al (2007) documented that institutional blockholdings have the potential to lower the yields on outstanding corporate bonds. However, this is just the case if and only if the firm has put in place several antitakeover measures which protect it from the market for corporate control.

Similarly, but in a slightly different context, Chava et al (2009) looked at how shareholder rights influence the cost of the bank loans of corporations. Their results show that companies which have fewer antitakeover devices in place pay on average significantly higher spreads on bank loans. The authors especially found that banks charge a higher loan spread to corporations presenting higher takeover vulnerability mainly because of their concern about a substantial increase in financial risk after the takeover.

Relatively to the quality of disclosure aspect, Sengupta (1998) especially showed a negative relation between the quality of a firm's disclosure and its cost of debt. In the same line, Yu (2005) also documented that the credit spread is negatively related to the quality of disclosure. Disclosure is especially an important governance mechanism in the sense it reduces default risk by reducing information asymmetry between the company and the lenders.

With respect to the environmental criterion, let us start with the paper of Bauer and Hann (2010). Relying on KLD scores as their main data source for CSR ratings, the authors documented a significant and negative relationship between good environmental management practices and a corporation's loan spread. On the contrary, they indicated a significant and positive relationship between a company's environmental concerns and its loan spread. There results therefore imply that firms which have better environmental management standards in place have lower loan spreads, and hence, exhibit lower costs of debt. In numerical terms, the authors claim that a corporate's environmental management practices can have an effect of up to 64 basis points on the loan spread on an annual basis. To

explain such results, the authors advanced that environmental practices influence the solvency of borrowing companies by determining their exposure to legal, reputational and regulatory risks. Schneider (2011) supports that view by highlighting the fact that poor environmental performance presents a significant downside risk in future cleanup and compliance costs when considering the increasingly strict environmental laws and regulations. According to him, these costs can be large enough to threaten the ability of polluting companies to meet their fixed payments to creditors. Therefore, bond yields of firms with relatively poor environmental performance will be upper those of firms with good environmental performance. On the same year, Goss and Roberts reported that companies with CSR concerns pay on average between 7 and 18 basis points more on their bank loans than firms without CSR concerns. The authors claim that banks evaluate CSR concerns as risk factors and therefore offer those companies "*less attractive loan contract terms*".
Relatively to the social aspect in particular, Bauer et al (2009) demonstrated that companies with stronger employee relations enjoy a statistically and economically lower cost of debt financing, higher credit ratings, and lower firm-specific risk. Verwijmeren and Derwall (2010) also support the idea that a corporation's interest in employee well-being is associated with a higher creditworthiness of the corporation. The lower default probability intuitively implies a lower cost of debt capital.

Overall, the literature on the relation between ESG/CSR and a firm's cost of debt is indicating a negative relationship between ESG/CSR quality and cost of debt. In other words, having good ESG/CSR scores usually leads to higher bond ratings because creditors nowadays realize that firms with improper ESG/CSR standards in place might be prone to particular environmental, social, and governance risks which could have dramatic effects on a firm's reputation or financial position. Better creditworthiness then induces, generally, a lower cost of debt (whether in the form of lower bond spreads or loan spreads of credit facilities).

Sustainability and the cost of equity

Papers on RI have not just concentrated on how it influences the cost of debt financing, but also on how the cost of equity financing is affected by CSR policies and ESG behavior. Given the conclusions drawn in the section relative to the cost of debt financing, one could expect that the risk-reduction characteristics of proper ESG/CSR standards also reduce the cost of equity financing. The empirical findings from the literature on ESG/CSR and the cost of equity generally support that idea.

Let us so look at some famous studies investigating the relation between the governance, environmental or social criteria and the cost of equity.

Over time, researchers have identified key governance attributes (namely the quality of firms' financial information, the ownership structure, the stakeholder rights, or even, the board structure) that are intended to reduce moral hazard and adverse selection problems present in publicly traded firms. Since those governance attributes are intended to reduce agency risks faced by equity stakeholders, they should have measurable effects on firms' cost of equity capital.

By assessing the effects of governance on expected returns, on firms' market beta, and on realized returns, Ashbaugh et al (2004) support the general hypothesis that firms with better governance present less agency risk to shareholders resulting in lower cost of equity capital. Firstly, the authors made in particular OLS regressions having as dependent variable the cost of equity[56] and as independent variables, various governance attributes. From there, they for instance observed that firms with less transparent earnings have a higher cost of equity or that companies with more independent audit committees have a lower cost of equity. Secondly, and importantly for us, they also regressed the market betas on different governance attributes and concluded to that respect that the quality of firms' governance reduces firms' exposure to market risk. About that, they found, for instance, that more independent boards reduce management tendencies toward over-investment, thereby lowering the market risk faced by shareholders. Thirdly, they also decided to capture a firm's overall governance risk by constructing a composite governance score. They added this governance factor to a classical Fama-French three-factor regression. They defined this fourth

[56] Measured here as the average expected return over the firm's fiscal year.

factor as the difference in returns between firms with the worst governance and firms with the best governance. The highly significant positive loading on the governance factor they found indicates that a portion of firms' realized returns is due to a governance risk premium. This finding suggests that poor governance exposes shareholders to greater agency risk which is another risk factor in addition to beta, size and market-to-book that affects companies' cost of equity. Governance thus seems to affect firms' cost of equity capital directly as well as indirectly via beta. Derwall and Verwijmeren (2007) presented pooled regression results having as a dependent variable a measure of implied cost of equity and, among explanatory variables, usual risk factors (beta, size, etc.) as well as an aggregate corporate governance index. With that respect, they concluded that firms with better governance enjoy a lower cost of equity capital. Then, they also used betas as dependent variable in pooled OLS regressions and suggest that leaders in corporate governance have lower systematic risk. Interestingly, they also found that better governance is associated with lower firm-specific risk.
Barth et al (2013) provided evidence that companies with more transparent earnings (thus having a good governance score at least to that respect), enjoy a lower cost of equity capital due to a reduction in information asymmetry. Their findings result from various manipulations with respect to the three factors of FF as well as to a momentum factor and an earning transparency measure.
Some studies are not limited to the US market. Chen et al (2009) especially investigated the link between the cost of equity capital and corporate governance in emerging markets. They showed, among other things, that firm-level corporate governance significantly reduced the cost of equity in those markets. Pae and Choi (2011) specifically focused on the Korean stock market and highlighted that corporations could reduce their cost of equity capital by adopting more comprehensive corporate governance practices and committing to higher standards of business ethics.

Let us now look at the link between the cost of equity and the environmental and social aspects. In 2014, El Ghoul et al reached the conclusion that firms experience lower cost of equity capital when they have higher corporate environmental responsibility (CER). In that international study, authors especially argued that the perceived risk of firms with high CER is lower than that of firms with low CER because CER helps decrease firms' risk by reducing the

probability and impact of adverse events[57]. In addition, they advanced that it is possible that firms caring about the environment will gain more visibility and positive publicity in the media, thereby attracting more investors. This increase in the number of shareholders will increase the firm's share price and decrease its cost of equity. Still in an international framework, Gupta (2015) demonstrated for her part that an improvement in environment-friendly practices leads to a reduction of the equity cost. The authors underlined that results are even stronger in countries where country-level governance is weak.

Heinkel et al (2001) showed them that exclusionary ethical investing leads to polluting companies being held by a lower number of investors since green investors avoid polluting firms' stocks. The lack of risk sharing among non-green investors leads to lower stock prices for polluting companies, thereby raising their cost of capital. Besides that, they also underlined that when the price differential between acceptable and non-acceptable companies grows large enough, it becomes optimal for unacceptable companies to pay the fixed cost of reforming (such that, making themselves acceptable to green investors).

Sharfman and Fernando (2008) isolated specifically in an OLS regression the CAPM' betas they estimated, and they discovered that firms with good environmental risk management faced lower systematic risk. As a result, those companies experience less volatility in their performance and the market appears to reward such behavior with lower costs of equity capital. In 2011, Salama et al used also CAPM' betas as depend variable and the corporate environmental performance alongside seven control variables as independent variables. Overall, the authors found evidence of a negative relationship between CER[58] ranking and beta. In a similar vein, Oikonomou et al. (2012) found a negative (positive) relation between CSP[59] strengths (concerns) and systematic risk for S&P 500 firms.

With respect to studies that globally focus on CSR and the cost of equity, Reverte (2011) made various regressions among which one was aimed to take the cost of equity capital as a dependent variable and, as independent variables, the three FF factors as well as a CSR reporting aggregate rating that he transformed into quintile ranks. Overall, he found a significant negative relationship between CSR disclosure quality scores and the cost of equity capital (especially for firms operating in environmentally sensitive industries). Cajias et al

[57] For instance, environmental scandals.
[58] Community and Environmental Responsibility.
[59] Corporate Social Performance.

(2012) used the FF three-factor model as a measure of cost of equity and showed that firms included in high-CSR portfolios have the tendency to have lower capital costs in comparison to low-CSR companies. By regressing the cost of equity on various CSR proxies and control variables using pooled cross-sectional time-series regressions, El Ghoul et al (2011) found that firms with better CSR scores (especially those which exhibit good responsible employee relations, environmental policies, and product strategies) witness cheaper equity financing. Moreover, the authors have shown that firms involved in tobacco and nuclear power face higher equity financing costs. Their results are consistent with the idea that high sustainable companies are perceived by the market to be less risky, and exhibit lower information asymmetry, which leads to a reduction in the cost of equity financing.

Albuquerque et al (2014) estimated firm systematic risk thanks to the Fama and French three-factor model. Using the estimated market betas as a dependent variable and their self-constructed composite CSR index among the explanatory variables, they run panel regressions and document that the level of systematic risk is statistically lower for firms with the highest CSR scores. This implies a reduced cost of equity financing, all else equal. A few years later, in 2018, Albuquerque, along with partly different researchers, focused themselves on the CAPM' betas found thanks to times-series regressions. They then used those betas as dependent variable in panel regressions. Constructing an overall CSR score, they also showed that the level of systematic risk is statistically significantly lower for companies with a higher CSR score.

Dunn et al (2017) performed Barra's GEM2L model to get, among other things, market betas. They also made various regressions among which one specifically had as dependent variable the betas and, as main explanatory variables, the ESG scores. With that respect, they discovered that stocks with poor ESG exposures tend to have higher betas. They also wanted to know which dimension of ESG drove the reduction in systematic risk. To this end, they made a regression having also the betas as dependent variable and the E, S and G pillars respectively as main independent variables. It appeared that the answer to their former question is the following one: the social and governance pillars.

Sassen et al (2016) evaluated the impact of European ESG scores on three risk measures (systematic, idiosyncratic, and total risk). Overall, their findings suggest that a higher ESG performance and a higher performance regarding the social dimension in particular have the potential to increase firm value through lower firm risk.

The voluntary disclosure of environmental practices further helps to reduce the cost of equity,

as shown by Dhaliwal et al (2011) who report that after volunteering CSR disclosures, companies with stronger CSR performance than that of their competitors are rewarded by a reduction in the equity cost of capital. In 2018, Breuer et al used an extensive international sample to examine the impact of CSR on equity cost under different levels of investor protection. The authors highlighted that in countries where investor protection is high (low), the cost of equity decreases (increases) when a company invests in CSR. The idea behind this result is that managers in countries where investors' legal protection is low may not engage in CSR out of a genuine desire to be environmentally and socially responsible, but instead extract private benefits through CSR spending.

Finally, let us quote the paper of Ng and Rezaee (2015) which examined both the aggregated and the decomposed influences of environmental, social, and governance aspects of CSR on equity cost. The authors found a negative relationship, which is lowest for the social dimension. In a previous study, Ng and Rezaee (2012) demonstrated that disclosure of sustainability performance reduces both debt and equity cost; statement that will furthermore be support by three other papers in the following point.

Zhu (2014) considered 23 developed countries and investigated the link between corporate governance and the cost of capital. In particular, she made regressions having as dependent variable either the cost of equity or the cost of debt, and, as independent variables, a firm's governance proxy and an extensive collection of risk and control variables which are demonstrated to affect a firm's cost of capital. She discovered that firms with good corporate governance are consistently associated with both lower cost of equity and cost of debt capital. To explain this result, she advanced that good corporate governance reduces insider expropriation and information risk, and therefore leads to lower costs of external financing. Chava (2011) used implied cost of capital derived from analysts' earnings estimates and performed various regression' models. She put in light that investors demand significantly higher expected returns on stocks excluded by environmental screens compared to firms without such environmental concerns. She also discovered that lenders charge a significantly higher interest rate on the bank loans issued to firms with these environmental concerns. Finally, carrying out international research on the effect of CR[60] on the cost of capital, Bassen et al (2006) chose beta as a marked-based risk measure and credit rating as a debt risk

[60] Corporate responsibility.

measure. Overall, the authors reached the conclusion that good CR-performance reduces both equity and debt financing costs.

The overall evidence provided up to now by the academic literature on ESG/CSR and its relation to the costs of corporate finance generally alludes to a negative effect of SRI on both cost of debt and equity capital.
Namely, good corporate governance standards, as well as superior corporate social and environmental standards lower a company's costs of financing significantly because those companies tend to exhibit lower risks, arising from reputational, financial or litigation concerns resulting from ESG/CSR scandals or issues.

Let us finally investigate in more detailed some additional papers specifically aiming at incorporating a new additional sustainable risk factor in traditional equity pricing models. Since the purpose of those papers is similar to the core hypothesis we will test in this Master' s thesis, it is appropriate to analyze them in detail.
In 2017, Jin published a paper whose title is straightforward; "*Is ESG a systematic risk factor for US equity mutual funds?*". To answer that question, the author modified the Fama-French five-factor model and incorporated an ESG-related factor[61] into it. Then, replicating the two-step procedure of Fama and MacBeth (1973), he estimated factor betas (loadings) of a large sample of funds through the time-series regression. As the next step, he estimated the reward earned per unit of exposure to risk factors through the cross-section regression.
Overall, he found that average coefficient on UME-beta is positive and statistically significant during the sample period[62]. The result confirms that ERP[63] should be positive for taking the ESG-related risk which we do not want exposure to. In other words, investors seem to be willing to forfeit a component of ERP for the down-side protection against the ESG-related risk. Hence, the conventional five factor model seems to overestimate the required rate of return on responsible investing by ignoring UME.
Hübel and Scholz (2019) investigated for their part the European market to mainly know whether taking ESG risk into account when managing equity portfolios enables investors to better assess the ESG risk exposures of their portfolios solely based on the high

[61] Called "UME". Note that here the authors use return difference between an ESG-score weighted portfolio and an unweighted market portfolio as an ESG-related factor (UME: unweighted minus ESG-score weighted).
[62] April 2014 to December 2016.
[63] Equity risk premium.

informational content of stock returns. To this end, they constructed three different ESG risk factors (E, S and G) to quantify the ESG risk exposures of firms. The E factor represented the returns of a zero-investment portfolio with long positions in firms with low environmental ratings and short positions in firms with high environmental ratings. The S factor and the G one were constructed analogously. Thanks to this step, the author then mainly analyzed whether taking these factors into account significantly enhances the explanatory power of standard asset pricing models (CAPM, Fama and French three-factor model or the Fama and French five factor model augmented by Carhart's momentum factor). The authors especially revealed that each of the three ESG factors contributes explanatory power. Importantly, they showed then that portfolios with pronounced ESG exposures show higher risks as the remaining stocks in the market. A large proportion of these risks can be explained by the ESG factors.

Relatively to the idea of considering sustainability as a new and specific risk factor in traditional pricing models, Koch and Bassen (2012)' paper as well as Görgen et al (2019)' paper can also be cited. Koch and Bassen (2012) investigated, among other things, whether carbon risk do affect the utility-specific cost of capital. To this end, they added this risk factor to CAPM in order to examine if investors demand a premium for bearing carbon price risks. Overall, the authors especially provide evidence that high-emitting utilities bear a carbon risk premium which translates into higher cost of capital. Görgen et al (2019) developed also a carbon risk factor to measure the sensitivities of firms to stock market's time-varying perception of risks arising from the transition towards a carbon-free economy. In more detailed, the authors bought a *"Brown-Minus-Green"* portfolio aiming at mimicking a factor related to carbon risk. They added then this carbon risk factor (BMG) in well-known Carhart' s model. The carbon beta in such a case is thus a capital market-based measure of carbon risk that captures the sensitivity of a firm to carbon risk. Overall, the authors performed extensive tests of BMG which support their notion of its relative importance for explaining variation in global equity returns during their sample period[64].

Finally, let us shed in light the paper of Girerd-Potin et al (2014). The authors aimed to redefine some independent socially responsible dimensions reflecting companies' coherent posture toward social issues other than the ESG classification mainly used in the literature. For this

[64] January 2010 through December 2016.

purpose, they used the six sub-ratings provided by the Vigeo agency and made a principal components analysis over their time period under study[65]. Their results highlight three main independent socially responsible dimensions that include business[66], societal[67] and financial[68] stakeholders. Then they have followed Fama and French (1993)' s methodology and constructed a *"nonsocial"* risk premium factor, called NMR (the return of low CSR companies minus the return of high CSR companies), for each of the three dimensions of CSR found earlier. As a next step, they analyzed the impact of the three SR risk premia on the return using an extension of the Fama-French three-factor model[69]. The results from this paper show that investors ask for an additional risk premium when they agree to hold low CSR stocks (based on the three factors defined previously), which is associated with low cost of equity for high CSR companies.

[65] December 2003 through November 2010.
[66] Employees, customers and suppliers.
[67] Environment and society.
[68] Stockholders and debt holders.
[69] Where RP,t is the return of portfolio P on month t, RM,t is the return of the market portfolio on month t, SMB is the return of the *"Small minus Big size"* Fama-French portfolio, HML is the return of the *"High minus Low BTM"* Fama-French portfolio, and NMR1, NMR2, NMR3 are the three SR-based portfolios bought previously.

Sustainability and market/accounting-based indicators of corporate performance

Understanding the relationship between sustainability and corporate performance has also spurred a large academic literature.

I will also structure this overview along the different aspects of CSR and ESG in order to provide a complete picture on the effects of the different individual facets of SRI on corporate performance.

The financial economics literature in general and the corporate finance literature in particular focused broadly on the relation between corporate governance quality and CFP.

One of the most prominent examples of research on the relation between takeover exposure and stock-price performance is that of Gompers et al (2003) who asked themselves the following question; *"Is there a relationship between shareholder rights and corporate performance?"*. Using 24 unique antitakeover devices, they built a Governance Index[70] as a proxy for the balance of power between managers and shareholders in each firm. Firms in the highest decile of the index are placed in the *"Dictatorship portfolio[71]"* and are referred to as having the *"highest management power[72]"* or the *"weakest shareholder rights"* while firms in the lowest decile of the index are placed in the *"Democracy portfolio[73]"* and are described as having the *"lowest management power"* or the *"strongest shareholder rights[74]"*.By analyzing the empirical relationship of this index with corporate performance, they discovered that an investment strategy that purchased shares in the lowest-G firms[75] and sold shares in the highest-G firms[76], earned abnormal returns of 8.5 percent per year during the sample period. To achieve this result, they made the four-factor model of Carhart[77] where the dependent variable was the monthly return difference between the Democracy and Dictatorship portfolios. Thus, the alpha in this estimation was the abnormal return on a zero-investment strategy that buys the Democracy portfolio and sells short the Dictatorship portfolio. For this

[70] The famous "*GIM index*".
[71] Characteristic of poor governance.
[72] A high value indicates stronger managerial power (less takeover pressure) and a greater potential for managerial entrenchment.
[73] Characteristic of good governance.
[74] The index construction was straightforward: for every firm, they added one point for every provision that restricts shareholder rights (increases managerial power).
[75] "Democracy" firms with strong shareholder rights.
[76] "Dictatorship" firms with weak shareholder rights.
[77] A model which simply adds a momentum factor to the traditional FF three-factor one.

specification, the alpha was about 8.5 % per year. Using the Tobin's Q[78] as a measure of firm value, they also discovered that firms with stronger shareholder rights had higher firm value. According to that study, good governance is therefore associated with higher equity returns and firm value. Bebchuk et al (2005) based their study *"What matters in corporate governance?"* on the one of Gompers et al (2003). However, they used only six[79] provisions among the 24 presented in the Gompers et al's paper to form their so called *"Entrenchment index"* and they also extended the time period[80]. Using exactly the same methodology as Gompers'one, they reached the same conclusion too. They indeed found that increases in the index level are associated with economically significant reductions in firm valuation as well as large negative abnormal returns. Cremers and Ferrell (2013) used the Governance Index of Gompers et al (2003)' study but they only focused on the link between it and firm value through the Tobin's Q measure. Extending furthermore the time period under study comparing to Bebchuk et al (2005)[81], they found that a higher G-Index is associated with lower firm valuation. Cremers and Nair (2005) provide similar evidence by studying the effects of both the takeover vulnerability and the strength of internal corporate governance mechanism. They measured the takeover vulnerability[82] of a firm by using data on anti-takeover provisions adopted by a firm. Their first external governance proxy uses the index developed by GIM as an anti-takeover index. The authors corroborated their findings by constructing an alternative index of takeover protection, which focuses on only three key anti-takeover provisions. They also considered two different proxies for internal governance[83]. As a whole, the authors find that a portfolio that goes long in firms with high takeover vulnerability and shorts firms with low takeover vulnerability creates an abnormal return of 10 % to 15% annually, depending on which proxy is used for internal governance. This result, however, only holds when internal governance is also strong, that is, only if public pension fund (blockholder) ownership is high as well. In 2006, Brown and Caylor used data from ISS to build their own firm-specific governance index (Gov-Score). As in the case of Cremers and Nair (2005), they investigated both internal and external governance factors. Overall, their summary governance measure is

[78] Note that the Tobin's Q equals the market value of a company divided by its assets' replacement cost.
[79] 4 constitutional provisions that prevent a majority of shareholders from having their way (e.g., staggered boards, limits to shareholder bylaw amendments, supermajority requirements for mergers, and supermajority requirements for charter amendments), and 2 takeover-readiness provisions that boards establish to be ready for a hostile takeover (i.e., poison pills and golden parachutes).
[80] Gompers et al (2003) focused on the 1990-1998 time period and Bebchuk et al (2005) on the 1990-2003 time period.
[81] They focused themselves indeed on the 1978-2006 period.
[82] (External governance).
[83] The percentage share ownership by institutional blockholders, defined to be an institutional shareholder with equity ownership greater than 5%, and the percentage of share ownership by public pension funds - who tend to be active shareholders.

significantly and positively related to firm valuation. Their results document so that effective corporate governance requires both internal and external measures, enhancing the validity of the Cremers and Nair (2005) findings. Still in the same vein as Gompers et al (2003), Core et al (2006) show that companies with more anti-takeover devices in place (i.e.: fewer shareholder rights as measured by the GIM index) display lower ROA[84].

In support to the results reviewed thus far, Bebchuk and Cohen (2005) found that firms with staggered boards[85] suffer in terms of lower valuations (measured by Tobin's Q). The importance of the board of directors is also underlined by Yermack (1996) who proved that more properly governed firms (i.e. smaller boards) perform better. Using again Tobin's Q as an approximation of market valuation, the author thus found an inverse association between board size and firm value.

There is also research showing that the governance environment of firms (i.e. the governance legislation) significantly affects operational performance and firm valuation. As an illustration, Giroud and Mueller (2010) focused on business combination laws[86]. By reducing the threat of a hostile takeover, BC laws weaken corporate governance and increase the opportunity for managerial slack. Consistent with the idea that competition mitigates managerial slack, the authors found that while companies in non-competitive industries experience, after the laws' passage, a significant drop in operating performance, corporations in competitive industries experience no significant effect. As far as that goes, the authors conducted event studies around the dates of the first newspaper reports about the BC laws. They discovered that companies in non-competitive industries experienced a significant stock price decline, contrary to firms in competitive industries which experienced a small and insignificant stock price impact. In 2011, Giroud and Mueller (2010) published another study in which they argued again that managerial incentive problems are first and foremost an issue for companies in non-competitive industries. Consequently, companies in competitive industries should benefit less from good governance, while firms in noncompetitive industries, where the lack of competitive pressure fails to enforce discipline on managers, should benefit relatively more. The authors found results that go in this direction. Looking either at firm

[84] Returns on assets.
[85] Hostile acquirers have a difficult time gaining control of companies with staggered boards (compared to traditionally elected boards).
[86] BC laws.

value[87] or operating performance[88], the effect of good governance[89] on corporations in competitive industries is small and insignificant while the effect of good governance in non-competitive industries is large and significant. The two papers written by Giroud and Muller are very specific in the sense they make a link between performance, governance, and competition.

The question of executive compensation practices has also been investigated in the literature. Research indeed showed that corporate performance is directly affected by executive compensation practices (Mehran 1995). Core et al (1999) also showed, for instance, that companies with weaker governance structures have greater agency problems. In turn, CEOs at companies with greater agency problems receive greater compensation. As a whole, firms with greater agency problems perform thus worse.

Aggarwal et al (2007) used governance attributes provided by ISS[90] to build a composite governance index for each company under study. As the one of Gompers et al (2003), their index was said to be *"additive"* in the sense the index is built as follows; it assigns a value of one to a governance attribute if the company meets minimally acceptable standards on that attribute and zero otherwise. Using that index, they compared the governance of foreign firms to the governance of comparable U.S. companies and they demonstrated that, on average, foreign firms have worse governance than matching U.S. firms. Approximately 8% of foreign firms have better governance than comparable U.S. companies. Next, they defined a firm's governance gap as the difference between the quality of its governance and the governance of a comparable U.S. company. By doing so, they found that the value[91] of foreign corporations increases with the governance gap. This result suggests that firms are rewarded by the markets for having better governance than their U.S. peers.

More indications to the positive effects of corporate governance on financial performance in a range of countries also exist, supporting the idea of a significant relation between corporate governance quality and company performance. For instance, Ammann et al (2010) used the dataset from GMI[92] and focused on 22 developed countries. In their study, they constructed three various governance indices; two of them are based on the additive approach and the

[87] Measured through industry-adjusted Tobin's Q.
[88] ROA, net profit margin or sales growth.
[89] As measured once again by the GIM index.
[90] Institutional Shareholder Services.
[91] Approximated again by Tobin's Q.
[92] Governance Metrics International.

last one is derived from a principal component analysis. Then, they estimated panel regressions of Tobin's Q on their three alternative governance indices and a set of control variables. The result of their paper is obvious: there is a strong positive relation between firm-level corporate governance and firm valuation. Like the previously mentioned study, that of Beiner et al (2005) was not interested in the USA. The authors focused on Switzerland and constructed a firm-specific governance index. As a whole, they reached the conclusion of a positive relationship between corporate governance and firm value (as measured by Tobin's Q).

To further underline the importance of good corporate governance, Karpoff et al (2008) namely published a paper called *"The cost to firms of cooking the books"*. They concentrated on firms that misreport earnings and found that the penalties imposed by the stock market are huge in contrast to penalties imposed through the legal system. On average, companies lose 38% of their market values when news of their misconduct is reported. According to the authors, 24.5% of these losses reflects the market adjusting to a more accurate representation of firms' financial situations. Another 8.8% reflects the expectation of legal penalties. The remaining 66.6% is labelled *"lost reputation"*. This is the decrease in present value of the firms' cash flows as investors, customers, and suppliers are expected to change[93] the terms of trade with which they do business with the company.

This study again underlines the bad implications of weak governance (ie: presence, here, of financial misrepresentations).

The literature on the governance criterion tackles many different facets of corporate governance and relates those to CFP measures. The picture that emerges from the literature is that well-governed firms perform - at least on average - better than poorly governed companies.

The literature has also investigated the effect of particular environmental and/or social issues on CFP. However, in comparison to the literature on corporate environmental performance in relation to financial performance, the evidence on corporate social performance and its effect on financial performance is not that broad.

Many papers used the so called *"event study methodology"* to analyze the link between

[93] Lower sales and higher contracting and financing costs.

financial performance and the cost of equity. Hamilton (1995) showed namely that stockholders in companies reporting TRI[94] pollution figures experienced negative, statistically significant abnormal returns upon the first release of the information. Those abnormal returns translated into an average loss of $4.1 million in stock value for TRI companies on the day the pollution figures were first released. Klassen and McLaughlin (1996) have namely investigated the stock price reaction to the announcement of positive environmental news and use the announcement of the winning of an environmental award (verified by a third-party organization) as their measure for good environmental performance. The authors showed that positive environmental news triggers positive stock price movements. Conversely, they also highlighted negative stock price reactions for adverse corporate environmental events. Flammer (2013) also used an event study to examine the stock price reaction to news or events. The author supported the conclusions of the previous study by shedding in light that the stock market reacted positively to the announcement of eco-friendly initiatives, and negatively to the announcement of eco-harmful behavior. Using again an event study, Capelle-Blancard and Laguna (2009) analyzed the response of the stock market to chemical disasters. They investigated in total 64 explosions in chemical plants at 38 different firms over the time period from 1990 to 2005. On the day of the explosion, the average stock price reaction is negative with 0.76%. Two-days after the event, shareholder lost on average 1.3%. This result is in line with their expectations. They indeed expected investors to react to a disaster because many costs, such as liabilities for personal injuries or environmental penalties, are uninsured or barely insurable. Moreover, after an accident, stakeholders are likely to modify their belief about the safety of the company. This may lead to a raise in insurance premiums, the expectation of tighter government regulation, or the worsening of relations with customers, employees, suppliers and investors.

White (1996) performed, as many authors after him did, a portfolio analysis study**.** He built three portfolios; Green[95], Brown[96], and Oatmeal[97] thanks to information provided by the Council on Economic Priorities (CEP). Then, he performed, for each portfolio, the famous CAPM in order to evaluate the risk-adjusted financial performance through Jensen's alpha. Because of the fact that the green portfolio was the only one to display a significant positive

[94] Toxics Release Inventory.
[95] Composed of firms with the highest rating with respect to environmental performance.
[96] Composed of firms with the lowest rating with respect to environmental performance.
[97] Composed of firms with a middle rating with respect to environmental performance.

alpha[98], he highlighted that one could have earned superior investment returns over the 1989 to 1992 period by purchasing the common stock of firms rated *"green"* by the CEP. Derwall et al (2005) investigated the concept of *"eco-efficiency"*, which can be thought of as the economic value a company creates relative to the waste it generates. The study constructed and evaluated two equity portfolios that differed in eco-efficiency. The hypothesis being tested was whether a portfolio constructed of environmentally efficient stocks will perform better than less efficient stocks. They reached the conclusion that the high-ranked portfolio provided substantially higher average returns than its low-ranked counterpart. In order to achieve such a result, the authors resorted to the CAPM, the Carhart four-factor model as well as a seven-factor model. In all cases, because the primary focus of the research was the performance differential between the high-ranked portfolio and the low-ranked portfolio, they provided the returns on a *"Difference"* portfolio, which was constructed by subtracting the low-ranked portfolio returns from the returns on the high-ranked stock portfolio. The influence of environmental screening on investment performance was thus finally simply the difference between the alpha on the high-ranked portfolio and the alpha on the low-ranked portfolio. By performing the seven-factor model, the results especially highlighted a 6.04% p.a. difference in alpha. Overall, the results suggest that the benefits of considering environmental criteria in the investment process can be substantial and they also raise the possibility that the market has undervalued eco-efficient firms relative to less eco-efficient companies. Kempf and Osthoff (2007) used the Carhart four-factor model[99] as well as SRI ratings. These ratings were useful to form one portfolio of stocks with high SRI ratings and another one of stocks with low SRI ratings. Overall, they authors showed that a long-short strategy (long in the high-rated stocks, short in the low-rated stocks) yields a positive four-factor alpha of up to 8.7% per year. Those two studies are especially good illustrations of the *"errors-in-expectations"* hypothesis. This hypothesis assumes that SRI can deliver anomalously high returns because of the fact that CSR information is value-relevant, and the financial markets do not understand that well[100]. In 2011, Guenster et al investigated, just like Derwall et al (2005), the concept of eco-efficiency. They reported that the lowest-ranked companies have values and ROA that are lower compared to those of the remainder of the sample.

[98] The green portfolio managed so to outperform the market.
[99] Note that the authors did also all the estimations using only the three Fama/French factors and results remain almost unchanged.
[100] The errors-in-expectations hypothesis predicts so that SRI can deliver superior returns due to the fact that the market systematically undervalues the importance of CSR.

Edmans (2011) specifically focused his paper on the social aspect by analyzing the relationship between employee satisfaction and long-run stock returns. The author found that, between 1984 and 2009, a value-weighted portfolio of the *"100 Best Companies to Work for in America"* earned a Carhart alpha of 3.5% per year. When compared to industry-matched benchmarks, the alpha remains a statistically significant 2,1%. His finding implies that the stock market does not fully value intangibles in the form of employee relations. In his follow-up paper, Edmans (2012) extends the sample period until 2011 and tests for any alphas over the new sample period from 1984-2011. Consistent with his earlier findings, the results indicate an alpha of 3.8% annually in excess of the risk-free rate. Likewise, the alphas adjusting for industries are higher than in the shorter sample period with 2.3% annually. Given that abnormal returns seem to survive over the longer term, the market has still not yet priced in all the information regarding employee satisfaction. Empirical results also show international evidence relatively to the positive relation between employee satisfaction and stock returns. Edmans et al (2014) investigated the relation of employee satisfaction and stock returns in 14 countries over several different time periods. Considering equal-weighted portfolios of the Best Companies, they founded that the alphas are positive for 11 out of the 14 countries. Another example of additional evidence is Fulmer et al (2003) who also focused on publicly traded firms included in the *"100 Best Companies to Work for in America"*. They analyzed the 1995-2000 period and the results of their stock returns analyses are generally supportive of the assumption under which companies included on the 100 Best list exhibit better performance relative to other firms. In 2006, Faleye and Trahan also concentrated on firms selected by Fortune magazine as the *"100 Best Companies to Work for in America"*. They investigated four measures of firm value and operating performance: Tobin's q, ROA, employee productivity, and total factor productivity. The authors found that the Best Companies significantly outperform a size- and industry-matched control group on all measures. Faleye and Trahan (2011) also support that view; they indeed found that labor-friendly firms outperform similar firms, both in terms of long-run stock market returns and operating results. Fu and Shan (2009)'s paper tests how a specific type of social responsibility-corporate equality-affects firm value. Corporate equality was measured by the CEI[101]. This index quantifies how companies treat their gay, lesbian, bisexual, and transgender employees,

[101] Corporate equality index.

consumers, and investors. Overall, the authors reached the conclusion that companies with a higher degree of corporate equality have higher stock returns and higher market valuation. Their results are, in that sense, similar to those in Gompers et al (2003). Fu and Shan (2009) provided evidence that corporate equality affects firm value through two channels: product markets and labor markets. Companies with higher CEI scores usually have more sales, higher profit margins, higher productivity in terms of total revenue per employee, and attract more employees. Their results suggest that corporate equality is appreciated by both consumers and employees, which can translate into higher firm value through better performance in product and labor markets.

Many other studies highlighted, over time, a positive relationship between social/environmental criteria and firms' performance. For example, Huselid (1995) investigated the impact of human resource management practices on turnover, productivity and corporate financial performance (namely through Tobin's Q). The author showed that investments in such practices go hand in hand with lower employee turnover as well as greater productivity and corporate financial performance. Jiao (2010) used the two-stage least squares regression method[102] to examine the valuation effect of stakeholder welfare. They constructed a stakeholder welfare score measuring the extent to which companies meet the expectation of their non-shareholder stakeholders[103] and find it to be associated with positive valuation effects: a raise of one in the stakeholder welfare score leads to an increase of 0.587 in Tobin's Q. Their result suggest that stakeholder welfare represents intangibles[104] crucial for shareholder value creation. Richard et al (2007) demonstrated for his part a positive relationship between racial diversity and Tobin's Q. For other, more specific social dimensions, there is also evidence of significant and positive effects on corporate performance. For instance, as shown by Simpson and Kohers (2002), banks that have better scores for *"Community Reinvestment Act Ratings"* exhibit better financial performance.

In 1997, Russo and Fouts made an analysis of 243 firms over two years, using independently developed environmental ratings. Executing OLS regressions, they reached the conclusion that higher environmental performance is associated with higher financial performance[105]. Thanks also to OLS regressions, Hart and Ahuja (1996) investigated the impact on performance of

[102] To avoid problems of endogeneity (Specifically here to avoid the problem of reverse causality).
[103] (Such as customers, employees, communities or environment).
[104] (Such as human capital or reputation).
[105] Measured through the ROA.

reduced pollution levels. They showed that pollution abatement is linked to higher ROS, ROE and ROA. In a similar vein, Clarkson et al (2004) showed that investments in pollution abatement technologies pay off, especially for companies that pollute less. Likewise, as shown by Darnall et al (2008) through their regression analysis results, the adoption of proper environmental management systems increases firms' performance. Dowell et al (2000) analyzed the global environmental standards of a sample of US-based MNEs[106] in relation to their stock market performance. The authors found that companies adopting a single, stringent global environmental standard have much higher market values, as measured by Tobin's Q, than firms defaulting to less stringent, or poorly enforced host country standards. Two possible explanations to their results can be made. Firstly, it may be that private valuations internalize environmental externalities: the less negative externalities a company imposes, the higher the company's value. Secondly, it is possible that adopting stringent environmental standards is actually more profitable than defaulting to lower or poorly enforced local environmental standards. These findings are consistent with Konar and Cohen (2001), who concluded that companies that are disposing of relatively smaller amounts of toxic chemicals, and those that are confronted with fewer or no environmental lawsuits, tend to have a higher Q. Additionally, carbon emissions have been found to affect firm value[107] in a significant and negative manner, as highlighted by Matsumura et al (2011). In the same line, King and Lenox (2002) highlighted a positive relation between waste prevention and company value[108] as well as between waste prevention and ROA.

Some other studies investigating the link between firms' financial performance and the environmental/social aspects found either a neutral or a significant negative relationship. Using a portfolio analysis study, Cohen et al (1997) constructed two industry-balanced portfolios and namely compared both accounting and market returns of the high polluter to the low polluter portfolio. Overall, they founded either no penalty for investing in the green portfolio, or a positive return from green investing. Making also a portfolio analysis study, Jayachandran et al (2013) have claimed their preference for investigating a specific dimension of CSR rather than to focus on an aggregate sustainability measure. They have found that a

[106] Multinational enterprises.
[107] In this study, it refers to market value of common equity (in millions of dollars). It is calculated using the number of shares outstanding multiplied by the price per share of the firm's common stock at the end of the calendar year.
[108] Measured through Tobin's Q.

firm's environmental social performance[109] (ESP) does not significantly relate to Tobin's Q. Fisher-Vanden and Thorburn (2011) provided some compelling evidence on the shareholder wealth effects of membership in voluntary environmental programs. They used an event study approach and documented a significant and negative stock market reaction upon the announcement of joining the voluntary environmental performance initiatives. Their study suggests that investors are interpreting participation in those programs as imposing a significant cost on the company. Shareholder value is therefore destroyed by voluntarily joining these programs. Hence, the authors conclude that corporate commitments to reduce GHG emissions appear to conflict with firm value maximization. In a similar vein, Jacobs et al (2010) also find a negative market reaction to the announcement of voluntary emission reduction initiatives participation. For these two studies, there seems so to be a persistent negative market evaluation of voluntary environmental management programs causing stock prices to fall on the announcement date of participation.

Given the reviewed evidence, I come to the conclusion that the social dimension of the ESG universe globally has a positive influence on CFP. With respect to the environmental dimension, the evidence is a little more mixed but, as a whole, companies with good environmental policies tend to have better CFP.

A number of studies look also at aggregated sustainability indices.
Let us first take a look at five so called *"event studies"*. Cheung (2011) investigated the effect on stock prices of addition to, or exclusion from, the Dow Jones Sustainability World Index. The author revealed that, on the day of change or on the days nearby, index inclusions have a positive effect while index exclusions have a negative effect on respective stock prices. Becchetti et al (2009) tracked the stock market reaction to entries and exits from the Domini 400 Social Index and noted that the abnormal returns around the event date are significantly negative in case of exit from the Domini index. Focusing on the Calvert index, Doh et al (2010) came to the same conclusion as the previous study. The authors indeed found that there is a negative shareholder wealth effect associated with a firm's deletion from the social index. Note that the three studies mentioned above take the inclusion (exclusion) in a social index as a proxy for a corporation's CSR quality (default).
Finally, and using also an event study, Godfrey et al (2009) wanted to know if CSR activities

[109] i.e.: environmental social performance.

could provide an insurance mechanism to preserve corporate financial performance. They provide evidence that sustainability quality provides insurance-like effects when negative events occur, helping to support the stock price upon the announcement of the negative event.

Another study which relates an aggregate sustainability score to stock market performance is the one of Eccles et al (2013). Using a four-factor model, they found that annual abnormal performance is higher for the high sustainability group compared to the low sustainability group by 4.8% on a value-weighted base and by 2.3% on an equal weighted-base. This finding points to the possibility of earning an alpha by investing in firms with a superior sustainability profile. The authors also found that high sustainability companies perform better when we consider accounting rates of return, such as ROE and ROA.

The effects of an aggregated sustainability measure have also been investigated in the context of corporate mergers and acquisitions. For instance, through the performance of a Carhart's regression, Deng et al (2013) showed that, by following a hedge portfolio strategy which goes long in acquirers with a better sustainability profile and goes short in acquirers with a worse sustainability profile, investors are able to realize an annual risk-adjusted alpha of 4.8%, 3.6%, and 3.6% over one-, two-, and three-year holding periods respectively. Aktas et al (2011) support the benefits of SRI in the case of a merger or acquisition. They showed that acquirer abnormal returns are positively associated with targets' social and environmental performance. Their result indicates that the better the target is in terms of environmental and social performance, the higher the gain for acquirer shareholders. This indicates that SRI in case of M&A announcements can be value creating.

Up to now, we have seen that many papers found that superior ESG/CSR quality translates into superior corporate performance relative to firms with lower ESG/CSR quality. Against this, there is some evidence indicating the existence of a negative or neutral relationship between aggregate sustainability scores and corporate performance.

Relatively to that, numerous papers compare the performance of SRI indices to conventional indices. Sauer (1997) namely used the Domini 400 Social Index for the socially screened portfolio along with S&P 500 and CRSP[110] value weighted market indexes as unrestricted benchmark portfolios. He first compared the average monthly raw returns and variability of

[110] Chicago Center for Research in Security Prices.

the DSI with the two unrestricted benchmark portfolios. Then, he examined Jensen's alpha for the Domini 400 Social Index using the Standard and Poor's 500 index and CRSP value weighted market index as proxies for the market return. Finally, he analyzed the transformed difference of the Sharpe' s index between the DSI and two unrestricted benchmark portfolios. Whatever the element under study, all results appear to be not statistically significant. As a whole, the empirical evidence presented in this paper clearly indicates that investors can choose socially responsible investments that are consistent with their value system and beliefs without being forced to sacrifice performance. Statman (2000) based his study on the comparison of the performance of the Domini Social Index and the S&P 500 index. He used Jensen's alpha as a measure of performance and reached the conclusion that there is not statistically significant difference in the performance of the two indices under consideration. In 2005, Statman (2000) published another study where he principally compared the performance of the S&P 500 index relatively to those of four indexes[111] of socially responsible corporations. Here he used the Fama and French three-factor model in the analysis of returns. His results led him to conclude that *"the hypothesis under which returns of socially responsible companies are equal to those of conventional companies cannot be rejected"*. Throughout the Schröder (2007) study, different settings to test performance are applied to the 29 SRI stock indexes under consideration. Overall, the performance tests indicate that the SRI screens for equities do not lead to a significant performance difference, neither an out- nor an under-performance. Statman and Glushkov (2009) analyzed returns of stocks rated on social responsibility by KLD and find that this tilt gave socially responsible investors a return advantage relative to conventional investors. However, typical socially responsible investors also shun stocks of companies associated with tobacco, alcohol, gambling, firearms, military, and nuclear operations. The authors found that such shunning brought to socially responsible investors a return disadvantage relative to conventional investors. The two effects largely balance out, so that socially responsible indexes have returns that are approximately equal to those of conventional indexes. Lee and Faff (2009), for their part, put in light that a leading CSP portfolio underperforms its lagging counterpart. One explanation they advanced is that higher returns for lagging CSP firms compensates for higher idiosyncratic risk. Overall, the authors provided empirical evidence in support of this view. They examined the influence of

[111] The Domini 400 Social Index, the Calvert Social Index, the Citizens Index, and the U.S. portion of the Dow Jones Sustainability Index.

idiosyncratic risk on various portfolio returns by constructing an idiosyncratic risk-mimicking portfolio in the spirit of SMB and HML. Interestingly, their results suggest that a significant proportion of the return difference of leading and lagging CSP firms or portfolios is plausibly explained by differences in idiosyncratic risk.

Angel and Rivoli (1997) predicted that a socially controversial stock that investors shun has a higher expected return, and that the expected return increases with the proportion of socially responsible investors in the market. In a similar vein, Hong and Kacperczyk (2009) showed that US sin stocks have higher expected returns than otherwise US comparable stocks. Those results are consistent with sin-stocks being neglected by norm-constrained investors and facing greater litigation risk[112] heightened by social norms. As a robustness check, they also extended their analysis outside of the US to seven large markets in Europe and to Canada. Even when considering these markets, they reached the conclusion that sin stocks do outperform other stocks. Using both CAPM and FF three-factor model, Fabozzi et al. (2008) also presented empirical evidence that sin stocks, have outperformed the market on a risk-adjusted basis. Notably, this result holds even when considering different sin industries and countries.

Servaes and Tamayo (2013)'s paper shows that CSR and firm value are positively related for firms with high customer awareness, as proxied by advertising expenditures. For firms with low customer awareness, the relation is either negative or insignificant. Xueming and Bhattacharya (2006) developed, tested and approved a conceptual model that proposes that CSR initiatives enable firms to build a base of satisfied customers, which in turn contributes positively to the market value of the firm. However, the authors showed that this reasoning is conditional to corporate abilities[113]. Notably, the authors find that in firms with low innovativeness capability, CSR actually reduces customer satisfaction levels and, through the lowered satisfaction, harms market value. Those last two studies imply a conditionality to have a positive link between financial performance and CSR.

Derwall et al (2011) constructed both a shunned-stock portfolio and a strong-employee-relations portfolio. The first one is based on the shunned-stock hypothesis and the second one on the errors-in-expectations hypothesis. They analyzed the evolution of the abnormal returns

[112] For instance, claims against the tobacco industry have especially included health harms (nicotine addiction or illness), wrongful death, healthcare costs (money spent treating those who get sick from tobacco products), involvement in smuggling, racketeering, conspiracy, defective product, concealment of scientific evidence, fraud, deception, misconduct, failure to warn consumers adequately of the dangers of tobacco products, negligence and exposure of the public to unreasonable danger.

[113] Product quality and innovativeness capability.

of both over the 1992-2008 time period. While the two portfolios provide significant abnormal returns in the short run, the alphas of the socially responsible portfolio diminish strongly in the long run and even become insignificant the latter years. As a reminder, the shunned-stock hypothesis predicts that shun stocks trade at relatively lower prices and offers higher expected returns due to lower risk sharing opportunities. The errors-in-expectations hypothesis predicts that SRI can generate higher returns due to the fact that the market systematically undervalues the importance of SRI. As a whole, the economic logic predicts that only one hypothesis can survive in the long run; over time, investors improve their understanding of the impact of SRI on companies' future cash flows and it is expected that superior returns due to the errors-in-expectations hypothesis will disappear (exactly as shown by the results of the authors).

In an interesting paper written by Hawn and Ioannou (2013), the authors investigated whether just symbolic CSR actions affect firm value or whether corporations have to undertake real, *"substantive"* CSR actions, in order to affect firm value. To answer that question, the authors use a composite CSR index based on the data provided by ASSET4 and which consists of sub-ratings regarding corporate ESG performance. Their results indicate that symbolic changes significantly increase Tobin's Q, while substantive CSR actions do not have any significant effect on firms' performance. This study suggests that companies with an established base of CSR resources might undertake symbolic actions largely because it is relatively less costly for them to do so, and also because such companies enjoy sufficient credibility with social actors to get away with it. It may be also simply the firm's past CSR reputation which matters for the future financial performance effects of newly introduced CSR actions. Another recent paper of interest is the one of Halbritter and Dorfleitner (2015) called "*The wages of social responsibility – where are they? A critical review of ESG investing*". The authors investigated the link between corporate social and financial performance based on ESG ratings from three different[114] ESG data providers. They followed two different strategies: an ESG portfolio method and cross-sectional regressions. Overall, their results suggest that investors should not expect abnormal returns by trading a difference portfolio of high and low rated companies with regard to ESG aspects.

There are also some studies which focus on the European market instead of the United States'

[114] ASSET4, Bloomberg and KLD.

one. Brammer et al (2006) namely investigated the relationship between corporate social performance and financial performance, measured using stock returns, for a sample of UK[115] quoted companies. Overall, the authors support so the argument that expenditure on some corporate social activities is destructive of shareholder value. To explain their result, the author namely argued that it may be the case that shareholders are willing to forgo returns in order to feel morally at ease with the stocks that they hold, so that required returns on the stocks of socially responsible firms are lower. Van de Velde et al (2005) used CSR rating from the French research firm Vigeo to test SRI portfolios in the EMU[116] area. They estimated three-factor alphas for the *"best"* and *"worst"* CSR portfolios for the 2000-2004 period. Their results indicate that high-CSR-rated portfolios perform better than low-rated portfolios, but not significantly so. Overall, their study suggests that there is no cost involved in integrating sustainable dimensions in the investment policy.

This section has provided an overview of studies which use an aggregate CSR measure in order to test the relation between CSR and CFP. The review that was established provides mixed findings, although the evidence points slightly more towards a positive relationship between CSR and performance.

Over time, some meta-studies, reports and literature reviews (available in Appendix 2) investigating the relation between sustainability and firms' performance have also been published and reach generally the aforementioned conclusion.

[115] United Kingdom.
[116] European Monetary Union.

Description of the data

As a reminder, we investigate in this study the impact firms' ESG commitment has on their cost of equity. More precisely, we analyze the influence of ESG on the *"Beta"* risk factor as well as on the risk-adjusted return before turning to the inclusion of a new ESG factor in traditional Fama-French asset pricing model.

To this end, I decided to work with a relatively high number of companies. More precisely, I chose a sample of two hundred companies[117] which are listed[118] on the S&P 500[119].

I collected ESG criteria for these firms on Yahoo Finance. The Yahoo Finance's website has indeed a *"Sustainability"* tab under which, each month, ESG data are updated. Note that all of those ESG data are in fact provided by Sustainalytics[120], one of the most famous third party ESG data providers previously mentioned in this work. On the Yahoo Finance site, I selected the overall ESG rating and also the individual scores for the environment, social and governance aspects. All of the ESG criteria were updated on February 2019.

Then, I also checked on Macrobond in order to download the daily adjusted closing prices for each of the two hundred companies for the year 2018. Focusing only on the year 2018 is justified by the fact that I only had ESG data for the month of February 2019.

As I chose to work respectively with the famous Capital Asset Pricing Model (CAPM) and the Fama-French three-factor model, it was then necessary to collect data on the risk-free rate, the return on the market, the historic excess returns of small-cap companies over large-cap companies and the historic excess returns of value stocks over growth stocks. I found all of those data in the data library of Kenneth French[121].

[117] See Appendix 3 for an overview of the firms belonging to the sample.

[118] Note that I have been on the following website in order to find companies included in the S&P 500 Index: https://www.zonebourse.com/S-P-500-4985/composition/.

[119] This index tracks 500 large U.S. companies across a wide span of industries and sectors. The S&P 500 Index represents approximately 80% of the total value of the U.S. stock market.
See, for instance, Cohen et al (1997); Dowell et al (2000); Matsumura et al (2011) or even Oikonomou et al (2012) who have also used S&P 500's firms in their paper.

[120] For more information on the way Sustainalytics establish ESG scores see: www.sustainalytics.com. See, for instance, Auer and Schuhmacher (2015) who also used data from Sustainalytics in their study.

[121] See: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

Brief presentation of the asset pricing models[122]

Focus on the Capital Asset Pricing Model

CAPM stands for Capital Asset Pricing Model. It is an economic theory which measures the cost of equity or, to put it differently, the rate of return an investor requires from a stock before looking into other viable opportunities.

According to CAPM, beta is the only relevant measure of a stock's risk. It measures a stock's relative volatility-that is, it shows how much the price of a particular stock jumps up and down compared with how much the entire stock market jumps up and down. Beta is thus, in other words, the stock's sensitivity to market risk[123]. If a share price moves exactly in line with the market, then the stock's beta is 1. If the beta of the stock is one, then it has the same level of risk as the stock market. A stock with a beta of 1.5 would rise by 15% if the market rose by 10% and fall by 15% if the market fell by 10%. If the beta of the stock is thus greater than one, then it implies higher level of risk and volatility as compared to the stock market. Conversely, a stock with a beta of 0.5 would rise by 5% if the market rose by 10% and fall by 5% if the market fell by 10%. If the beta of the stock is less than one and greater than zero, it implies the stock prices will move with the overall market. However, the stock prices will remain less risky and volatile.

The CAPM formula is the following one:

Cost of equity[124] = Risk-free rate + Beta*Market risk premium

Where:

- The Risk-free rate (Rf) would be the rate that is expected on an investment that is assumed to have no risk involved.
- Beta is the factor's coefficient (sensitivity).
- The Market risk premium is the difference of the Return on the market (Rm) and the Risk-free rate (Rf).

[122] Section especially developed thanks to Womack and Zhang' s (2003) paper.
[123] Market risk, also known as non-diversifiable risk or systematic risk, is the risk attributable to market factors that affect all firms and that cannot be eliminated through diversification. For example, if there is inflation, all companies experience an increase in prices of inputs, and generally their profitability will suffer if they cannot fully pass the price increase on to their customers.
[124] Also known as *"Required rate of return"* or *"Expected return"*.

Focus on the Fama and French three-factor model

As previously said, CAPM uses a single factor, beta, to compare a portfolio with the market as a whole. But more generally, factors can be added to a regression model to give a better R-squared fit. The best-known approach like this is the three-factor model developed by University of Chicago professors Eugene Fama and Kenneth French in the 1990s.

Fama and French started with the observation that two classes of stocks tend to do better than the market as a whole: (i) those of small-cap companies relative to those of large-cap companies (ii) those of high book-to-market companies versus those of low book-to-market companies. They then added two factors to CAPM to reflect a portfolio's exposure to these two classes.

The FF three-factor formula is thus:

Cost of equity = Risk-free rate + $Beta_1$*Market risk premium + $Beta_2$*SMB + $Beta_3$*HML

Where:

- SMB (Small Minus Big) is a size effect based on a market capitalization of a corporation. SMB measures the historic excess of small-cap companies over big-cap companies.
- HML (High Minus Low) is a value premium. It represents the spread in returns between companies with a high book-to-market ratio (value companies) and companies with a low book-to-market ratio (growth companies).

As a whole, the Fama and French three-factor model is an expansion of the Capital Asset Pricing Model. The model is adjusted for outperformance tendencies. Also, two extra risk factors make this model more flexible relative to CAPM.

Research methodology

Based on all of the data described in the previous section, I first estimated the average annual return for each company. This is used to make simple statistical and econometric exercises at the beginning of the next section[125] and also at the very end of it, as a dependent variable of the final regressions. The average annual return for a firm i (R_{i2018}) is calculated as follows:

Equation used to determine the average 2018 return (R_{i2018}) for a given company

- Mean of $\{[(P_{it}-P_{it-1})/P_{it-1}]*100\}$ (**1**)

Where P_{it} is the adjusted closing price of a particular firm at time t and P_{it-1} is the adjusted closing price of a given firm at time t-1.

Thanks to these average annual returns, I first performed cross-sectional regressions having has a dependent variable the average 2018 return and, as independent variable, the ESG, E, S or G scores.

Equation used to run cross-sectional regressions having as a dependent variable the average 2018 returns (R_{i2018}) and, as an independent variable, the ESG, E, S or G scores

- $R_{i2018} = c + \eta_{ESG} ESG_i + \varepsilon_i$ (**2**)
- $R_{i2018} = c + \eta_{E} E_i + \varepsilon_i$ (**3**)
- $R_{i2018} = c + \eta_{S} S_i + \varepsilon_i$ (**4**)
- $R_{i2018} = c + \eta_{G} G_i + \varepsilon_i$ (**5**)

Where η_{ESG}, η_{E}, η_{S} and η_{G} are the coefficients related respectively to the ESG, E, S and G factors, c is the constant and ε_i is the random error.

Then, I estimated, for each company under study, the excess return. The excess return is simply the return minus the risk-free rate.

Equation used to determine the excess return of a given company

- $\{[(P_{it}-P_{it-1})/P_{it-1}]*100\} - R_{ft}$ (**6**)

Where R_{ft} is the risk-free rate at time t.

[125] That is to say, *"Discussion of findings"* (Equations 2,3,4 and 5).

This excess return is in fact the dependent variable used in order to run the CAPM and FF time-series regressions. Given the fact that I had 251 observations for the risk-free rate[126] for the year 2018 and a variable number of returns depending on the company considered, I used the "*RECHERCHEV*" function available on Excel to make a matching of the dates.

Next, I first realized the 200 CAPM time-series regressions[127] according to the following equation:

Equation used to run the CAPM time-series regression for a particular company

- $R_t - R_{ft} = \alpha + ß_m (R_{mt} - R_{ft}) + Ɛ_t$ (7)

Where R_t is the expected return of the security at time t, R_{ft} is the risk-free rate at time t, α is the alpha of the security, $ß_m$ is the beta of the security, R_{mt} is the return of the market at time t, $R_t - R_{ft}$ is the excess return of the security at time t, $R_{mt} - R_{ft}$ is the market premium at time t and $Ɛ_t$ is the random error of the security at time t.

Thanks to the previous step, I already had the dependent variable (the excess return) and the independent variable in this case is the market premium ($R_{mt} - R_{ft}$), collected on the Kenneth French website.

Thanks to those regressions, I do obtain, for each company, a constant (called *"alpha"*) and a beta related to $R_{mt} - R_{ft}$ ($ß_m$).

Following the same reasoning, I then ran 200 FF three-factor model time-series regressions[128]. Here I still had the excess return as a dependent variable but three independent variables; the market premium as well as the SMB and HML factors.

Equation used to run the Fama-French three-factor model time-series regression for a particular company

- $R_t - R_{ft} = \alpha + ß_m (R_{mt} - R_{ft}) + ß_s SMB_t + ß_h HML_t + Ɛ_t$ (8)

Thanks to these regressions, I get for each firm an alpha, a beta related to Rm-Rf ($ß_m$), a beta related to SMB ($ß_s$) and, finally, a beta related to HML ($ß_h$).

From here, I had all the necessary data to develop the main hypothesis at the heart of my Master' s thesis as well as the two peripheral investigations[129].

[126] As well as for Rm-Rf, SMB and HML.
[127] See Appendix 5 as an example for Abbott Laboratories.
[128] See also Appendix 5 as an example for Abbott Laboratories.
[129] Note that for the two peripheral investigations, the econometric logic I used can be justified thanks to the paper of Ziegler et al (2007) who used both CAPM and FF three-factor model and made first time-series regressions followed by cross-sectional ones.

The first one peripheral investigation is to see if the betas related to the market premium (either of the CAPM[130] or of the FF three-factor model[131]) are influenced by sustainable data. To test this hypothesis, I made cross-sectional regressions having as a dependent variable the betas[132] related to market premium and, as independent variable(s), the ESG scores, the E scores, the S scores, the G scores, or the E, S and G scores.

Equations used to test the first peripheral investigation

- $\widehat{ß}_{im} = c + \lambda_{ESG} ESG_i + \varepsilon_i$ (9)
- $\widehat{ß}_{im} = c + \lambda_E E_i + \varepsilon_i$ (10)
- $\widehat{ß}_{im} = c + \lambda_S S_i + \varepsilon_i$ (11)
- $\widehat{ß}_{im} = c + \lambda_G G_i + \varepsilon_i$ (12)
- $\widehat{ß}_{im} = c + \lambda_E E_i + \lambda_S S_i + \lambda_G G_i + \varepsilon_i$ (13)

Where $\widehat{ß}_{im}$ are the betas related to the market premium of the CAPM or of the FF three-factor model; c is a constant; ESG_i are the global ESG scores and λ_{ESG} the related coefficient; E_i are the environmental scores and λ_E the related coefficient; S_i are the social scores and λ_S the related coefficient; G_i are the governance scores and λ_G the related coefficient; ε_i is the random error.

The second peripheral investigation is to see if the alphas[133] (either of the CAPM[134] or of the FF[135]) are impacted by the sustainable data. To test that, I made cross-sectional regressions having as a dependent variable the alphas and, as independent variable(s), the ESG scores, the E scores, the S scores, the G scores, or the E, S and G scores.

Equations used to test the second peripheral investigation

- $\hat{\alpha}_i = c + \lambda_{ESG} ESG_i + \varepsilon_i$ (14)
- $\hat{\alpha}_i = c + \lambda_E E_i + \varepsilon_i$ (15)
- $\hat{\alpha}_i = c + \lambda_S S_i + \varepsilon_i$ (16)
- $\hat{\alpha}_i = c + \lambda_G G_i + \varepsilon_i$ (17)
- $\hat{\alpha}_i = c + \lambda_E E_i + \lambda_S S_i + \lambda_G G_i + \varepsilon_i$ (18)

[130] See, for instance, Sharfman and Fernando (2008) or Salama et al (2011) who investigated CAPM' betas.
[131] See, for instance, Albuquerque et al (2014) or Gregory et al (2014) who investigated market betas from the FF three-factor model.
[132] Of the CAPM or, of the FF three-factor model.
[133] See, for instance, Fabozzi et al. (2008) or Tripathi and Bhandari (2016) who used both pricing models in their paper to analyze abnormal returns.
[134] See, for instance, White (1996), Statman (2000) or Derwall et al (2005) or who analyzed abnormal returns thanks to the CAPM.
[135] See, for instance, Statman (2005) or Van de Velde et al (2005) who analyzed abnormal returns thanks to the FF three-factor model.

Where $\hat{\alpha}_i$ are the alphas of the CAPM or of the FF three-factor model.

Finally, the main hypothesis is to see if the average annual return (R_{i2018}) can, among other things, be explained by the creation of a fourth factor; namely an ESG factor, an E factor, a S factor or a G factor.

Let us take the example of the ESG factor as an explanation but keep in mind that the logic is the same for the creation of the E, S or G factor.

In order to construct the ESG factor, I ranked my two hundred companies according to their global ESG rating.

Then, I selected the first and last deciles[136] of these ranking, representing respectively companies that excel and those that, conversely, have the lowest performance in ESG. As a result, I obtained two portfolios, each containing twenty firms.

From there, I recovered the data of the returns of the companies included in the low ESG portfolio or in the high ESG one.

Next, I calculated the means of the returns of the 20 firms in the first decile and the means of the returns of the 20 firms in the last decile. As a result, I did obtain one high ESG equally weighted portfolio as well as one low ESG equally weighted portfolio.

My ESG factor was estimated by subtracting the means of the returns of the best ESG companies from the means of the returns of the poorest ESG companies. This new factor can in fact be viewed as a kind of investment strategy that takes a long position in low ESG portfolio stocks and a short position in high ESG portfolio stocks.[137]

Then, I performed 200 time-series[138] regressions[139] having as a dependent variable the excess return and, as independent variables, the market premium as well as the SMB, HML and ESG factors.

Equations used for the time series regressions linked to the core hypothesis

- $R_t - R_{ft} = \alpha + ß_m (R_{mt} - R_{ft}) + ß_s SMB_t + ß_h HML_t + ß_{ESG} ESG_t + Ɛ_t$ (19)

[136] See, for instance, Halbritter and Dorfleitner (2015) who sort companies based on their sustainable scores and then take the best/worst quintiles to form the fourth factor they use latter in times series regressions.

[137] This factor is so constructed in the same logic as the SMB and HML factors. Those factors can be viewed as a strategy which is, respectively, long on portfolio with small-cap stocks/high book-to-market and short on portfolio with large-cap stocks/low book-to-market. See also Ashbaugh et al (2004), Hübel and Scholz (2019), Görgen et al (2019) or Girerd-Potin et al (2014) for a construction almost identical to mine of the sustainable risk factor.

[138] See Appendix 8 as an example for Abbott Laboratories.

[139] As an example, to justify the econometric procedure of the core hypothesis, see the Jin (2017)'s paper. The author followed the two-step procedure of Fama-MacBeth; performing first times-series regressions and then, a cross-sectional one. As a reminder, he did it to analyze the relevance of a novel sustainable factor in a classical pricing model.

Where ESG_t is the fourth factor I created and $ß_{ESG}$ its related coefficient.

Thanks to these regressions, I got for each firm an alpha, a beta related to Rm-Rf ($ß_m$), a beta related to SMB ($ß_s$), a beta related to HML ($ß_h$) and, finally, a beta related to ESG ($ß_{ESG}$).

Relatively to the creation of the E, S, or G factor, the equations are the following ones;

- $R_t - R_{ft} = \alpha + ß_m (R_{mt} - R_{ft}) + ß_s SMB_t + ß_h HML_t + ß_E E_t + \varepsilon_t$ (**20**)
- $R_t - R_{ft} = \alpha + ß_m (R_{mt} - R_{ft}) + ß_s SMB_t + ß_h HML_t + ß_S S_t + \varepsilon_t$ (**21**)
- $R_t - R_{ft} = \alpha + ß_m (R_{mt} - R_{ft}) + ß_s SMB_t + ß_h HML_t + ß_G G_t + \varepsilon_t$ (**22**)

Finally, I ran a final regression, of cross-sectional type, having as a dependent variable the average annual returns for the year 2018 and, as independent variables, the coefficients $ß_m$, $ß_s$, $ß_h$ and $ß_{esg}$ of equation 19.

Equations used for the cross-sectional regressions linked to the main hypothesis

- $R_{i2018} = c + \chi_m \hat{ß}_{im} + \chi_s \hat{ß}_{is} + \chi_h \hat{ß}_{ih} + \chi_{ESG} \hat{ß}_{iESG} + \varepsilon_i$ (**23**)

Where $\hat{ß}_{im}$, $\hat{ß}_{is}$, $\hat{ß}_{ih}$ and $\hat{ß}_{iESG}$ are now variables and χ_m, χ_s, χ_h and χ_{ESG} their related coefficients.

About the creation of the E, S, or G factor, the equations are so;

- $R_{i2018} = c + \chi_m \hat{ß}_{im} + \chi_s \hat{ß}_{is} + \chi_h \hat{ß}_{ih} + \chi_E \hat{ß}_{iE} + \varepsilon_i$ (**24**)
- $R_{i2018} = c + \chi_m \hat{ß}_{im} + \chi_s \hat{ß}_{is} + \chi_h \hat{ß}_{ih} + \chi_S \hat{ß}_{iS} + \varepsilon_i$ (**25**)
- $R_{i2018} = c + \chi_m \hat{ß}_{im} + \chi_s \hat{ß}_{is} + \chi_h \hat{ß}_{ih} + \chi_G \hat{ß}_{iG} + \varepsilon_i$ (**26**)

Discussion of findings

Let us now investigate an essential part of this Master' s thesis, namely the discussion of findings. These were obtained through numerous calculations and econometric operations. In this part, I will first expose some descriptive statistics before taking a look at some histograms. Then, we will consider some scatter plots and correlations and finally, we will turn to the description of the regression analysis.

Note that the stars present in the tables refer to the three common significance levels. More precisely, *** indicates significance at the 0.01 level or better, ** indicates significance at the 0.05 level or better, * indicates significance at 0.10 level or better.

Descriptive statistics

Table 1 below, presents the results of the descriptive statistics for the following variables; R_{i2018}, ESG scores, E scores, S scores and G scores. These four elements are central to my analysis, hence the need to take a little time to browse them in more detail.

We can see that, when considering the two hundred companies, the mean of the average returns for the year 2018 is negative (-0.0013217).

The mean of the global ESG scores is 61.5.

Among the three factors (environmental, social and governance), firms appear to make the best performance regarding to the environmental aspect (mean of 64.235) and they show the least good result on the social aspect (mean of 59.23).

If we look at the maximum and minimum lines, it is surprising to see that this is with respect to the environment that we face the most extreme results. Indeed, in this column, we have an exceptional score of 98 and, conversely, a very poor score of 36.

We can take a look at the standard deviation, a measure that is used to quantify the amount of variation or dispersion of a set of data values. In our table, the standard deviation is without surprise the highest in the third column, meaning that the data points are spread out over a wider range of values when considering the environmental aspect.

Then, we have the skewness which reflects the asymmetry of a distribution. Given the fact that the skewness of each variable is comprised between -0.5 and 0.5, it can be said that the

distribution of each variable is approximately symmetric[140].

Finally, we also have the kurtosis which reflects the characteristics of the tails of a distribution. In the table, the kurtosis are above 3 in the two first columns meaning that we face leptokurtic distributions while the last three columns have a kurtosis lower than 3 meaning that we face there platykurtic distributions.

Table 1: Descriptive statistics of the variables R_{i2018}, ESG, E, S, and G

	R_i2018	ESG scores	E scores	S scores	G scores
Mean	-0.013217	61.50000	64.23500	59.23000	62.97500
Median	-0.006210	62.00000	64.00000	59.00000	63.00000
Maximum	0.194861	87.00000	98.00000	88.00000	79.00000
Minimum	-0.292825	41.00000	36.00000	38.00000	41.00000
Std.Dev.	0.079354	8.188115	12.85832	10.54481	7.749493
Skewness	-0.209736	0.030008	0.075517	0.266496	-0.339123
Kurtosis	3.449300	3.196237	2.399165	2.861118	2.930933
Observations	200	200	200	200	200

Histograms

In this part, I found it relevant to realize the histograms relating to the ESG, E, S and G scores.[141] Those histograms will provide a visual interpretation of numerical sustainable data by showing the number of sustainable data points that fall within a specified range of values (called *"intervals"*).

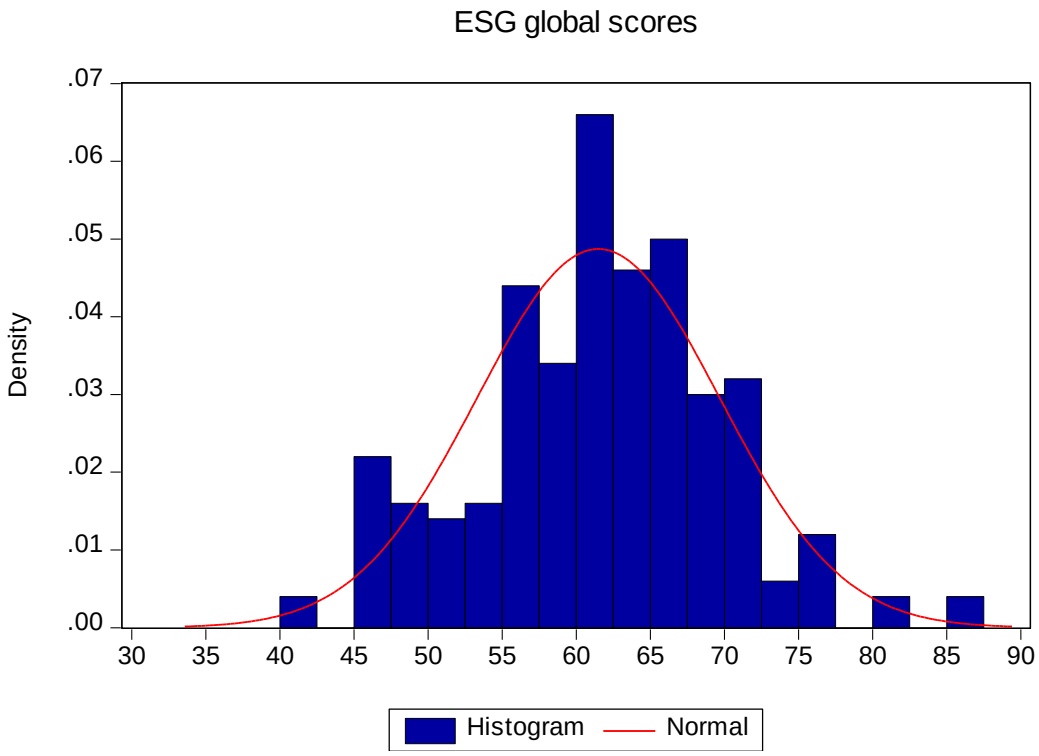
Most interestingly, they will allow us to have a clear visualization of the distributions of the sustainable data - distributions which were already analyzed in the previous section through the various skewness and kurtosis.

The ideal for the relevance of our subsequent analyses would be to have distributions that are as close as possible to a normal one.

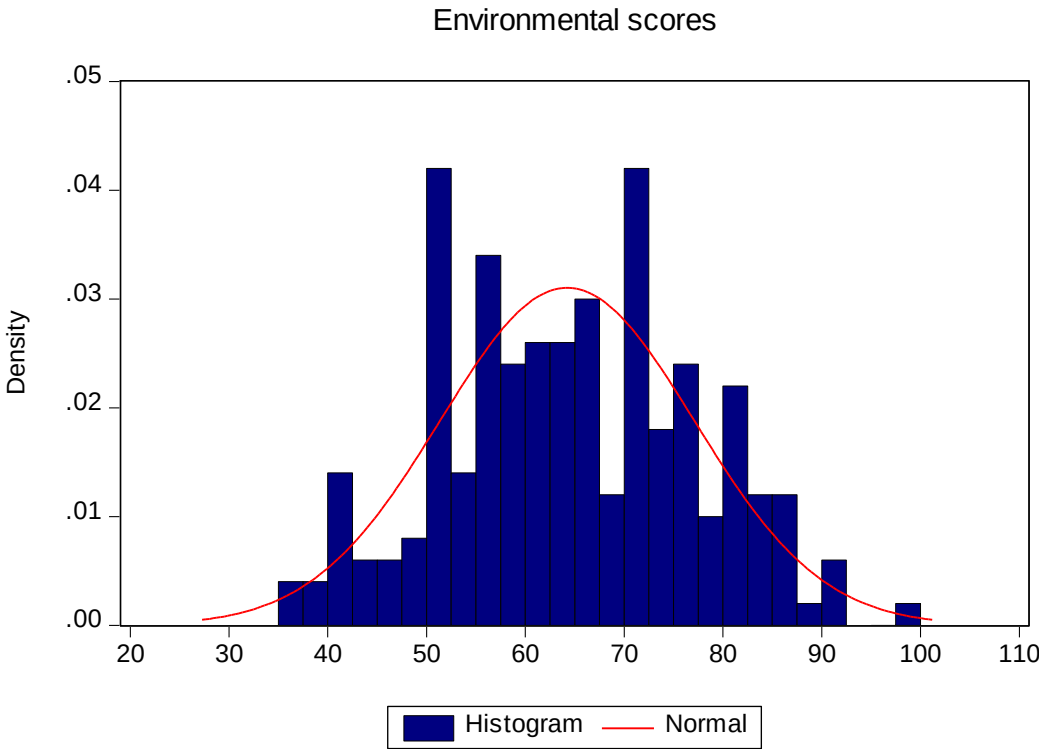
[140] Bulmer (1979) established a rule of thumb under which a skewness comprised between -0.5 and 0.5 implies an approximately symmetric distribution.

[141] See for instance Ammann et al (2010) who represented the empirical distributions of their two additively constructed corporate governance indices. Another example is the one of Beiner et al (2005) who have also representing the empirical distribution of their corporate governance index. Both papers did it to verify the distribution's symmetry as well as to ensure they are substantial differences in firm-level corporate governance between firms belonging to the sample. Statman (2005) represented also, as another example, the distribution of the social scores of companies belonging to his study.

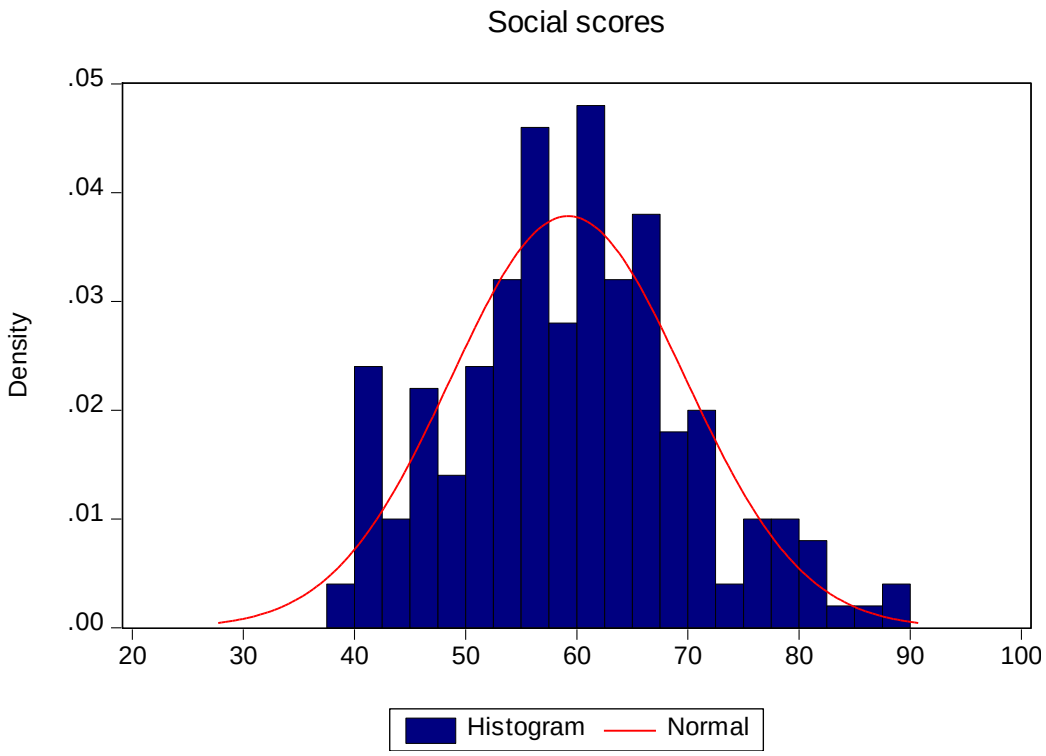
Histogram 1: Representation of the ESG global scores



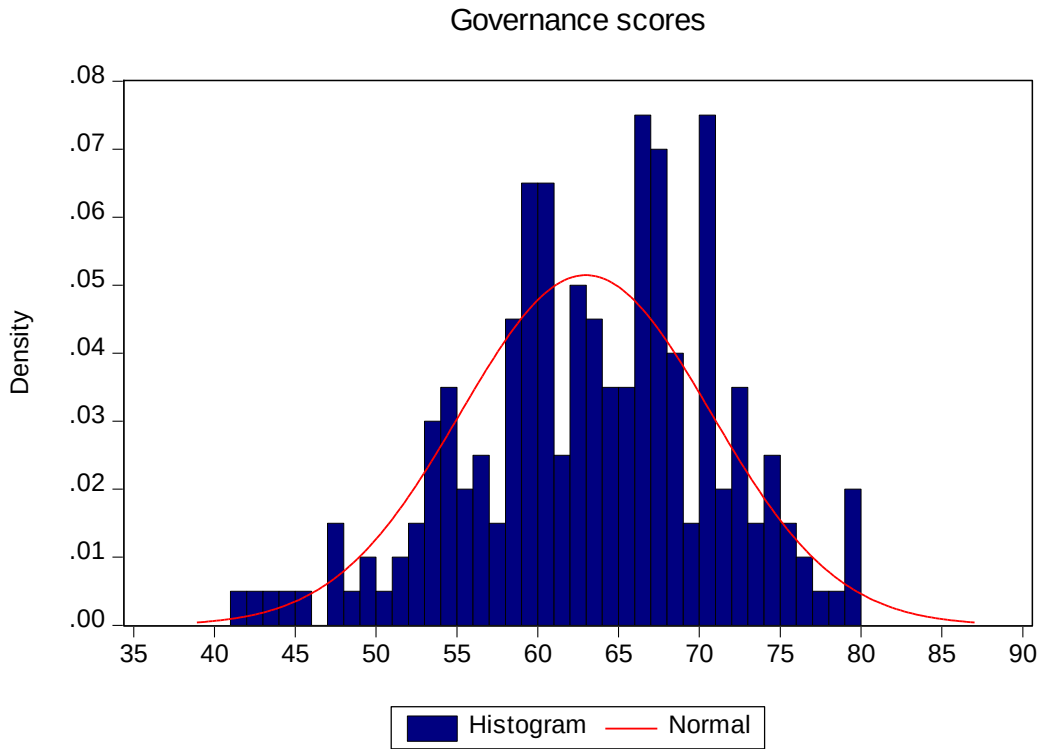
Histogram 2: Representation of the environmental scores



Histogram 3: Representation of the social scores



Histogram 4: Representation of the governance scores



Relatively to the first two histogram, namely the one relative to the global ESG scores and the one related to the environmental criterion, we can see that we face distributions which look quite symmetric, which is consistent with, respectively, the skewness of 0.030008 and the one of 0.075517 previously obtained. Those values are very close to the skewness of a normal distribution (0). With respect to the third histogram, we can see that the bulk of the data is a little bit more on the left and that the right tail is slightly longer. Those facts are the sign of a weak positively skewed distribution. We remain again consistent with the low positive value of the skewness relative to the social aspect (0.266496) previously found. Finally, when looking at the fourth histogram, the bulk of the data is a little bit more on the right and the left tail is slightly longer, implying a negatively skewed distribution. Once more, it is coherent with respect to the low negative skewness (-0.339123) previously notified.

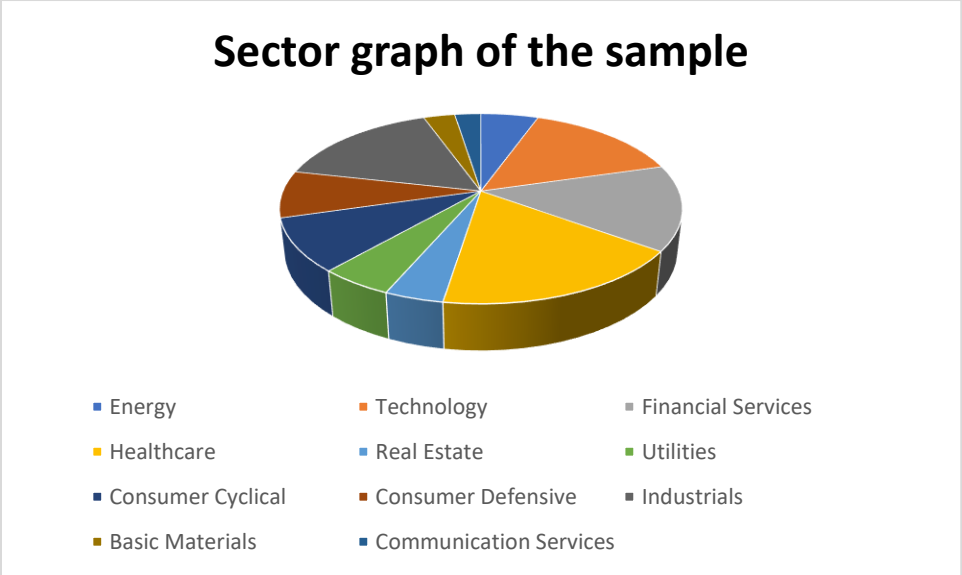
Considering the degree of tailedness in the variable distributions, which is measured through the kurtosis' coefficients, we can hardly draw a conclusion based on the graphs of the ESG, social and governance scores. This is consistent with the kurtosis previously obtained, which were, in each case, close to the threshold value of 3. When looking at the second histogram, we can here draw a conclusion thanks to the tails of the distribution. Indeed, tails appear to be thinner than those of the normal distribution, implying a platykurtic distribution and so, a kurtosis lower than 3. In the previous section, we got a kurtosis of 2.399165 relative to the environment aspect. This value is once again consistent with our graphical analysis.

As a whole, the distributions' characteristics of our sustainable data are very close to the one of a normal one - namely a kurtosis of 3 and a skewness of 0. This implies, on the one hand, that among our sample all kinds of RI firms are represented (those with poor ESG performance as well as pioneers in the field) and, on the other hand, that this representation is fair (the two hundred companies are not attached to some specific scores; there is then neither over nor under representation of a given ESG score).
My sample of sustainable corporations is thus truly representative and well suited to perform regressions which especially aim to make statistical inference.

Sector graph

When quickly looking at the sector graph of the sample[142], we can see that there are more than ten different sectors that are represented, which implies that the sample is also very diverse with regard to companies for which ESG criteria have been investigated. This is again a positive point in a perspective of statistical inference.

Figure B: Sector graph of my sample



Scatter plots and correlations

Next, I found it interesting to realize scatter plots of the ESG, E, S or G score and the average annual return for the year 2018 (R_{i2018}).

Scatter plots are important in statistics because they can show the extent of correlation, if any, between the variables under study.

If no correlation exists between the variables, the points appear randomly scattered on the coordinate plane. If a large correlation exists, the points concentrate near a straight line. Scatter plots are therefore useful data visualization tools for illustrating a trend.

Note that I added to this scatter plot a regression line to have a better visualization of the potentially existing correlation.

As you will observe in Table 2, I also calculated the different correlation coefficients of Pearson; those values will be useful to complete our analysis in this section. Indeed, their

[142] See, for instance, Reverte (2011) or Eccles et al (2013) who described also the sector composition of their sample.

value, always comprised between -1 and 1, will inform us about the intensity of the linear relationships as well as about the sign (positive or negative) of those relationships. Finally, under the *"Preliminary results"* tab of the next section, I performed regressions between the average annual returns for the year 2018 and the ESG, E, S, or G scores in order to find, among other things, the p-value associated to the various correlation coefficients. Those p-values will give us information about the statistical significance of the results. Moreover, the simple regression models described above will allow us to quantify the extent to which one variable can promote a positive or negative change in another variable.

Table 2: Correlation coefficients of Pearson

	R_{i2018}	ESG scores	E scores	S scores	G scores
R_{i2018}	1				
ESG scores	-0.11774298	1			
E scores	-0.047550586	0.813175993	1		
S scores	-0.138050528	0.828770209	0.446821273	1	
G scores	-0.054396211	0.566114921	0.269355659	0.332139859	1

Figure C: Scatter plot of the ESG global scores and the average annual returns for the year 2018

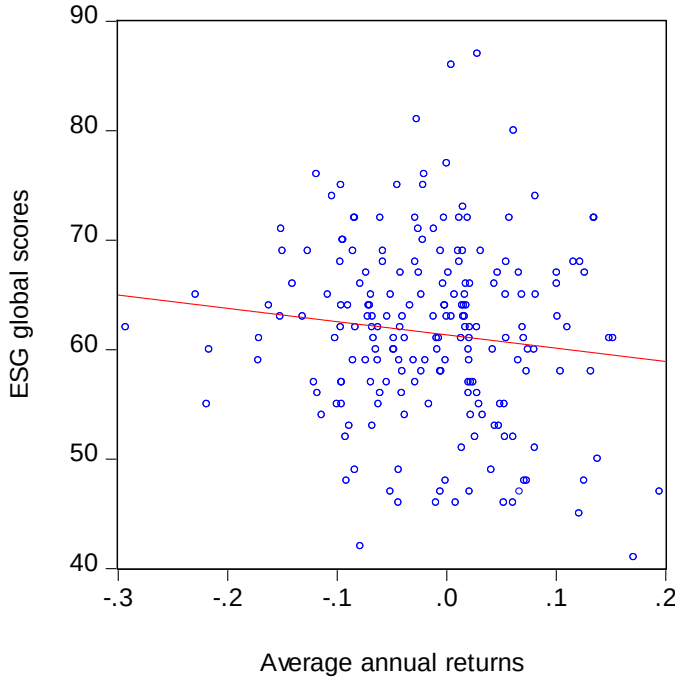


Figure D: Scatter plot of the environmental scores and the average annual returns for the year 2018

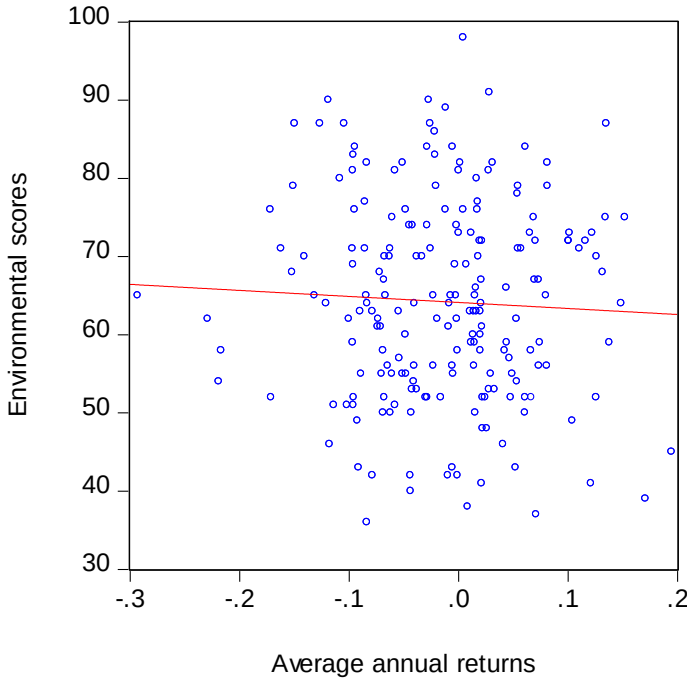


Figure E: Scatter plot of the social scores and the average annual returns for the year 2018

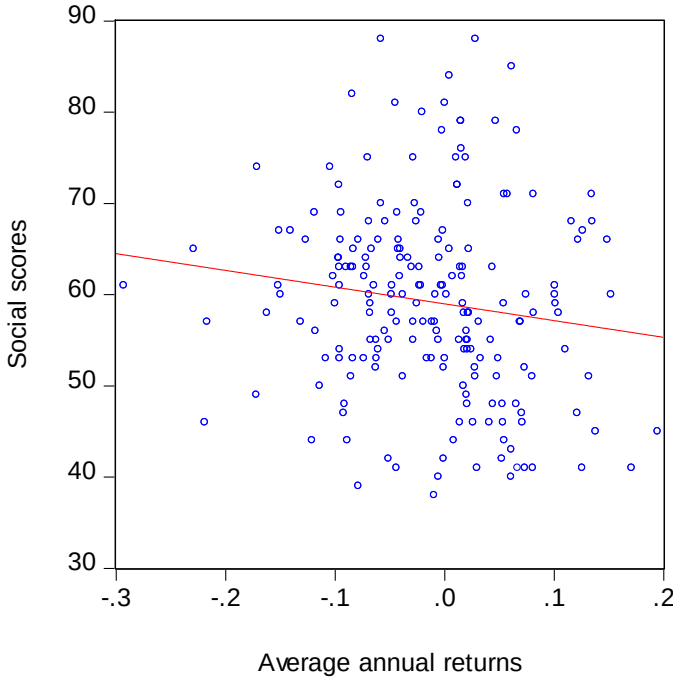
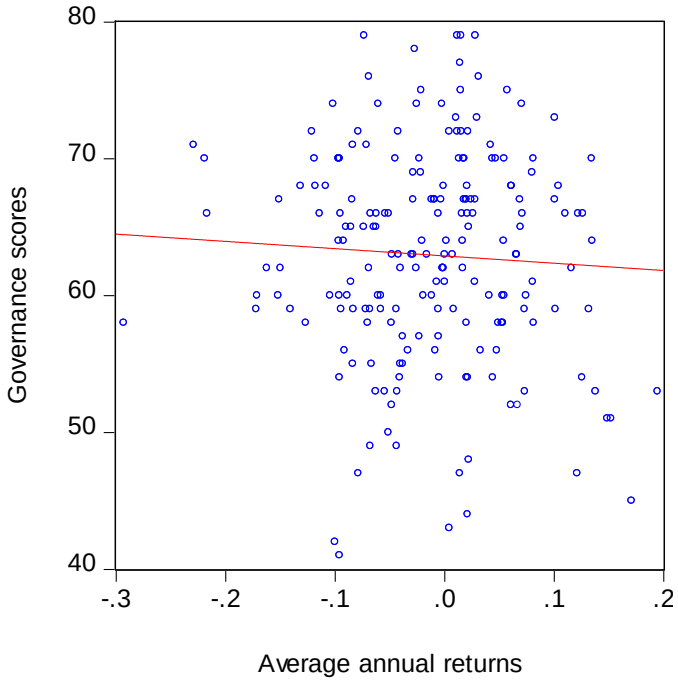


Figure F: Scatter plot of the governance scores and the average annual returns for the year 2018



On the first figure, we can see that there is a negative correlation between the two variables. Indeed, the higher the average annual return, the lower the overall ESG score.

By calculating the correlation coefficient, I do obtain a number of -0.11774298. We can thus say that we face a low negative correlation.

I also estimated the p-value associated to this coefficient of correlation. I got a p-value of 0.0968 meaning that our observation appears to be statistically significant considering the 10% level of significance.

The three other figures are there to see separately the correlation between the average annual returns for the year 2018 and the environmental, social and governance scores.

By focusing on the environmental scores, we still observe a negative correlation with the average annual returns; the lower the environmental score, the higher the average annual return.

The correlation coefficient in this case is - 0.047550586. The correlation between the two variables is still negative but lower than considering the total ESG score.

The p-value associated to this second coefficient of correlation is equal to 0.5037. It means here that our result is not significant from a statistically point of view.

If we care about the social scores, we can again notice a negatieve correlation with the average

annual returns for the year 2018. Here, when the social score is big, the return is low.
This criterion reflects the higgest negative correlation with the average annual returns given the fact that its correlation coefficient has a value of - 0.138050528. The estimated p-value related to the coefficient is 0.0512. That means that this result is clearly statistically significant at the 1% level.
Finally, if we look at the governance scores, we still see a negative correlation with the average annual returns; when the return is high, the governance score is lower.
The estimation of the correlation coefficient, whose value is - 0.054396211, certifies us that there is a low negative correlation between the variables. The estimated p-value is about 0.4443. That means that our result is not statistically significant.

Regressions Analysis

a) Preliminary results

In this part and, as previously said, I firstly made an OLS regression having as a dependent variable the average annual returns for the year 2018 and, as independent variable, the global ESG scores. Note that all tables presented in this section are available in their entirety in Appendix 4 of this Master' s thesis and that the green number in tables' title refers to the number of the equation I used to obtain such results.

Table 3: Cross-sectional regression having as a dependent variable the average annual returns for the year 2018 and, as an independent variable, the global ESG scores (**2**)

Dependent Variable: Average annual returns in 2018 Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.056960	0.042432	1.342379	0.1810
Global ESG scores	-0.001141	0.000684	-1.668396	0.0968*

This regression shows us that when a company improves its ESG score by one unit, its average annual return decreases by -0.001141 percent.

I then did three other OLS regressions using the same logic but taking as independent variable the environmental, social and governance scores. The results obtained in this regard are shown below.

Table 4: Cross-sectional regression having as a dependent variable the average annual returns for the year 2018 and, as an independent variable, the environmental scores (**3**)

Dependent Variable: Average annual returns in 2018 Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.005633	0.028696	0.196289	0.8446
E scores	-0.000293	0.000438	-0.669854	0.5037

Here, we can see that when a firm enhances its environmental score by one unit, its average annual return decreases by -0.000293 percent.

Table 5: Cross-sectional regression having as a dependent variable the average annual returns for the year 2018 and, as an independent variable, the social scores (**4**)

Dependent Variable: Average annual returns in 2018 Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.048316	0.031864	1.516307	0.1310
S scores	-0.001039	0.000530	-1.961322	0.0512*

Looking at the social scores, we can note that when a corporation upgrades its social score by one unit, its average annual return will diminish by -0.001039 percent.

Table 6: Cross-sectional regression having as a dependent variable the average annual returns for the year 2018 and, as an independent variable, the governance scores (**5**)

Dependent Variable: Average annual returns in 2018 Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.021860	0.046104	0.474160	0.6359
G scores	-0.000557	0.000727	-0.766557	0.4443

Finally, considering the governance aspect, the fourth regression highlights that when a company improves its governance score by one unit, its average annual return decreases by -0.000557 percent.

Up to know, we can so conclude that the sustainability performance of corporations seems to go hand in hand with a deterioration of their average annual return. However, the only relations being statistically significant are those between the average annual returns and the global ESG scores as well as those between the average annual returns and the social scores.

b) Results linked to the potential impact of ESG criteria on market betas

Here, I will first expose the results of the regressions having as a dependent variable the market betas derived from the CAPM and, then, those derived from the Fama-French model. This part belongs to our first peripheral analysis and will allow us to get gradually an in-depth comprehensiveness of the impact of sustainability on classical pricing models.

As previously said, beta is a measure of the volatility, or systematic risk, of a security or a

portfolio in comparison to the market as a whole. The market beta is therefore of paramount importance, hence a section specifically dedicated to analyzing it.

As we have observed in the literature review, some authors have, over time, investigated the potential impact of sustainability on the cost of equity through the beta attached to the market premium. To justify the econometric manipulations achieved in this section, three papers can especially be put forward.

In 2014, Gregory et al constructed equally weighted *"green"* and *"toxic"* stocks portfolios for various CSR indicators[143] as well as for a global CSR score. In each case[144], they ran the Fama and French three-factor model and, then, they compared the market betas of the two portfolios. In 2008, Sharfman and Fernando have, for their part, used the CAPM as a measure of equity cost of capital. They then used those betas as dependent variables and performed OLS regressions having as explanatory variables three control variables[145] and, importantly for us, an environmental criterion. Finally, Ziegler et al (2007) performed cross-sectional regressions that are based on time-series regressions of asset pricing models (CAPM and FF). Those papers first justify the fact that both the CAPM and the FF three-factor model can be used when analyzing the impact of sustainability on a firm's market beta. Secondly, the first paper underlines that it is useful to investigate both a global sustainable measure as well as to analyze individually the different components of this measure. Then, the second paper used the beta as dependent variable and especially sustainable data among the explanatory variables. The last paper highlight the logic of temporal and transversal investigations. For my part, I used the market betas of both pricing models and I analyzed the global ESG score as well as the E, S and G scores. I obtained the various market betas thanks to times-series regressions and I then performed cross-sectional regressions having as dependent variable the betas in question and, as explanatory variables, sustainable data.

Let us now investigate the regressions' results attached to CAPM's betas and sustainable data. Note that all tables presented in this section are available in their entirety in Appendix 6 of this Master' s thesis.

[143] Environment, community, product, employee...
[144] Ie: for each CSR indicator as well as for the global CSR score.
[145] The financial leverage, the log-market capitalization and the industry.

Table 7: Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as an explanatory variable the ESG scores (**9**)

Dependent Variable: Betas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.898510	0.183158	4.905644	0.0000***
ESG scores	0.000327	0.002952	0.110851	0.9118

Table 8: Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as an explanatory variable the E scores (**10**)

Dependent Variable: Betas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.679905	0.121927	5.576312	0.0000***
E scores	0.003717	0.001861	1.996638	0.0472**

Table 9: Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as an explanatory variable the S scores (**11**)

Dependent Variable: Betas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.959430	0.137879	6.958482	0.0000***
S scores	-0.000689	0.002292	-0.300493	0.7641

Table 10: Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as an explanatory variable the G scores (**12**)

Dependent Variable: Betas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	1.698942	0.189873	8.947772	0.0000***
G scores	-0.012391	0.002993	-4.140455	0.0001***

Table 11: Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as explanatory variables the E, S and G scores (**13**)

Dependent Variable: Betas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	1.485204	0.202672	7.328121	0.0000***
E scores	0.006325	0.001990	3.178285	0.0017***
S scores	-0.000473	0.002478	-0.190813	0.8489
G scores	-0.015004	0.003132	-4.790423	0.0000***

Foremost, it is important to note that all explanations mentioned below are made under the assumption of independence between the sustainable data and the error terms.

Systematic risk is typically macro-economic in nature. Examples include interest rate shocks, oil price shocks, economic growth rate shocks and inflation shocks, all of which affect the majority of stocks, though some stocks are more exposed to this type of risk than others. Some key elements (such as the financial leverage, the operating leverage or even the nature of business) affect the beta of a security by making firms more exposed to adverse macro-

economic conditions[146]. As a I did not have the possibility to account for these control variables in the following regressions by lack of data' s availability, their influence on the betas are naturally found in the error' s terms. In order to properly interpret my results, the assumption of independence between ESG data and the error' s terms is thus important.

If we look at table 7, we see that the p-value attached to the ESG coefficient is extremely high, implying that the global ESG scores seems to have no impact on the CAPM' betas of the sample. Given the statistical significance of some results set out just below, this result particularly highlights the importance of not only considering an aggregated explanatory variable when performing OLS analysis.

Table 8 indicates that the coefficient of the environmental criterion is positive and statistically significant. We can see that, when companies increase their environmental performance of one point, their beta increases by 0.003717. More precisely, if firms improve their E score by one point, their systematic risk increases by 0.004046213%[147] relative to beta's sample mean.

The social score has here no impact on firms' betas; the coefficient attached to the social criterion is indeed not statically significant as we can observe in table 9.

The governance score seems to decrease the beta of firms given the fact its value is negative (-0.012391) and highly statically significant whatever the threshold considered. Here, when firms improve their G score by one point, their beta decreases by -0.01348846% relative to beta's sample mean.

Finally, when looking at table 11, we can see that the coefficient of the environmental criterion is still negative and even more statistically significant than what as observed in table 8.

The coefficient related to the governmental score is still negative and also more significant than what notified in table 10. In that case, we note that when companies improve their E score by one point, their beta increase by 0.0068852% while when enhancing their G score of one point, their beta decrease by -0.0163329%. In that case, considering simultaneously the E, S and G scores thus seems to improve the quality precision of my model through lower standard deviations and thus, higher t-stats.

[146] The financial leverage refers to debt taken on by the firm; the more debt a firm takes on, the higher the beta will be in that business. The operating leverage is a measure of the proportion of fixed cost to the overall cost. The greater the proportion of fixed costs in the cost structure of the business, the higher the beta. Finally, a last important point affecting the beta of a firm is the nature of business. Cyclical companies have generally higher betas than non-cyclical firms and discretionary product firms will have higher betas than firms that sell less discretionary products.

[147] This percentage is obtained by dividing the coefficient' value (0.003717) by the mean of the CAPM' betas. See for instance, Albuquerque et al (2014) who proceed exactly this way to interpret the effect of CSR on market' beta.

Now, I will present the results of the regressions having as a dependent variable the market betas derived from the Fama and French three-factor model. The three-factor model extending the CAPM, it also provides a richer way to model exposure to systematic risk.

Table 12: Cross-sectional regression having as a dependent variable the betas derived from the Fama-French three-factor model and as an explanatory variable the ESG scores (**9**)

Dependent Variable: Betas FF 3 factor model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.899333	0.171119	5.255600	0.0000***
ESG scores	0.000492	0.002758	0.178340	0.8586

Table 13: Cross-sectional regression having as a dependent variable the betas derived from the Fama-French three-factor model and as an explanatory variable the E scores (**10**)

Dependent Variable: Betas FF 3 factor model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.735361	0.114195	6.439497	0.0000***
E scores	0.003024	0.001743	1.734386	0.0844*

Table 14: Cross-sectional regression having as a dependent variable the betas derived from the Fama-French three-factor model and as an explanatory variable the S scores (**11**)

Dependent Variable: Betas FF 3 factor model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.897928	0.128832	6.969781	0.0000***
S scores	0.000534	0.002142	0.249568	0.8032

Table 15: Cross-sectional regression having as a dependent variable the betas derived from the Fama-French three-factor model and as an explanatory variable the G scores (**12**)

Dependent Variable: Betas FF 3 factor model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	1.702010	0.176458	9.645433	0.0000***
G scores	-0.012266	0.002781	-4.410251	0.0000***

Table 16: Cross-sectional regression having as a dependent variable the betas derived from the Fama-French three-factor model and as explanatory variables the E, S and G scores (**13**)

Dependent Variable: Betas FF 3 factor model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	1.476683	0.188765	7.822865	0.0000***
E scores	0.004915	0.001854	2.651266	0.0087***
S scores	0.001559	0.002308	0.675450	0.5002
G scores	-0.015167	0.002917	-5.199039	0.0000***

When analyzing the results of the regressions having as dependent variables the market betas derived from the Fama-French three-factor model, the results are almost identical to those described under the section dedicated to the observation of the CAPM' market betas. The only variables appearing to be statistically significant are once again the environmental and governance scores. While the former still increase the beta, the latter ones still appear to

lower the market-risk factor.

From the analyses of the CAPM and FF three-factor' market betas, we can so conclude that an improvement of the environmental score goes hand in hand with an increase of the systematic risk while enhancing the governmental performance decreases the beta attached to the market premium. A portion of the effects of governance and environment commitment on the cost of equity capital thus seems to be captured by firms' exposure to systematic risk. Beta being a key factor in asset pricing models, those results therefore suggest that, through the systematic risk channel, environmental leaders face an increase in their cost of equity while governance leaders seem to face a decrease in their cost of equity.

Let us now try to provide some plausible explanations to both aforementioned results. Relatively to the influence of governance on beta, Garmaise and Lui (2004) suggested that the transfer of decision rights on investment choices to managers exposes shareholders to a more levered claim on the market because managers have a taste for actions such as empire building (overinvestment) that increases payoffs in good economic times but exaggerates losses in bad economic times. The authors derived a prediction that bad corporate governance combined with corruption (dishonest management) increases firms' systematic risk and provide empirical support for this prediction in a cross-country empirical test. Hence, within the Garmaise and Liu (2004) framework, agency risks associated with the transfer of decision rights on investments are, at least in part, captured by beta. In other words, and as a suggestive explanation to our result, we can expect that governance mechanisms that foster greater monitoring and control of management's opportunistic actions will impact firms' cost of equity capital indirectly by lowering firms' exposure to systematic risk.
In a similar vein, we can suggest that financial information quality can have an influence on beta. For example, the more transparent earnings are, the more current earnings reflect information about the firm's current economic activities. More transparent earnings result in less information asymmetry between the firm and its shareholders which, in turn, should lead to a lower cost of equity capital. This reduction in equity cost may result partly from higher quality financial information reducing market risk (Ashbaugh et al (2004)).
Note that our finding is consistent with the results highlighted in the literature review (Remember for instance Ashbaugh et al (2004) or Derwall and Verwijmeren (2007)).
With respect to the impact the environmental criterion has on market beta, the result is here

contrary to what we observed in the literature review. Indeed, papers of Sharfman and Fernando (2008) or Salama et al (2011) concluded to an environment commitment inducing lower systematic risk. In such views, companies may, for instance, be able to accomplish a reduction in beta by implementing environmental risk management operating changes to increase their flexibility to manage economic downturns. As an example, firms that have invested in clean technology, insulation etc. will be less vulnerable to price increases in energy inputs. By reducing the variability in performance, the company will likely reduce its beta, which also should lead to lowered equity cost. It is also possible that companies which have invested in environmental programs that utilize renewable energy and clean fuels or other companies that make great efforts to ensure the optimal quality and safety characteristics of their products and services might be better equipped to cope with adverse systematic economic shocks than their competitors who are not dedicated to such practices (Oikonomou et al (2012)). As another example, it can be advanced that since ESG technology is a product differentiation strategy, this implies that green companies face a relatively less price elastic demand and can charge higher prices ceteris paribus. From the perspective of a risk-averse investor, a company facing a less price elastic demand exhibits lower systematic risk and has a higher firm value (Albuquerque et al (2014)). Our results however indicate that environmental leaders seem to face have higher systematic risk. One explanation we could provide to that respect is that the commitment of a firm to improve its environmental score is associated with risk taking. Indeed, the company enters a process of transformation and any process of change generates uncertainty. This uncertainty being shared by a large number of firms in the market, it could be found in the market risk component of systematic risk. Another explanation we can advance is that firms which improve their environmental performance may face higher operating costs. Those higher operating costs imply higher risk and, especially, higher systematic risk because of firms' higher vulnerability to price changes, recessions, etc.

c) Results linked to the investigation of sustainability' s influence on risk-adjusted returns

In this section, I will first expose the results of the regressions having as a dependent variable the alphas derived from the CAPM and I will then expose the regression tables which focus on the three-factor alphas. Once again, the results exposed in this section are made under the implicit assumption of independence between the sustainability data and the error' s terms.

Before looking at the regressions' results, it is wise to firstly define precisely what is the alpha (also known under the name *"Jensen's alpha"* in the CAPM case) and, secondly, to justify, given the literature on the subject, the relevance of the regressions outlined below.

Jensen's measure is in fact a risk-adjusted performance measure that represents the average return on a portfolio or investment, above or below that predicted by the CAPM, given the portfolio's or investment's beta and the average market return.
Jensen's alpha represents the average risk premium per unit of systematic risk. Consequently, Jensen's alpha is an appropriate risk-adjusted measure of portfolio performance for investors that are well diversified and, therefore, primarily concerned with their exposure to systematic risk. If the CAPM represents the correct equilibrium pricing model, then a statistically significant positive alpha would imply superior investment performance and a statistically significant negative alpha would imply substandard investment performance relative to a naive buy-and-hold investment strategy that includes combinations of the market portfolio and the risk-free asset.
In a sentence, the alpha is therefore simply used to determine the abnormal return of a security or portfolio of securities over the theoretical expected return.

Over the last few years, many papers have investigated the link between sustainability and companies' market-based performance. Most of those papers specifically examined this relationship using the CAPM and/or the Fama-French three-factor model. The authors of the papers then, most of the time, made various analysis of the inherent alphas.
Four papers can especially be highlighted to justify the progression of this section. The first one is that of Tripathi and Bhandari (2016) which uses both the CAPM and the Fama-French three-factor model to analyze the performance of socially responsible stocks portfolio. Then, we have the one of Auer and Schuhmacher (2015) which uses the global Sustainalytics ESG criterion as well as Sustainalytics E, S or G scores to analyze risk-adjusted performance. Eccles (2013) specifically used four-factor alpha as dependent variable in an OLS regression to evaluate the impact sustainability has on it. Finally, Ziegler et al (2007) performed cross-sectional regressions that are based on time-series regressions of asset pricing models.
For my part, I used the alphas of both pricing models and I analyzed the global ESG score as well as the E, S and G scores. I obtained the various alphas thanks to times-series regressions and I then performed cross-sectional regressions having as a dependent variable the alphas in

question and, as explanatory variables, sustainable data.

Let us now turn to the in-depth analysis of the regressions having as a dependent variable the alphas derived from the CAPM. Note that all tables presented in this section are available in their entirety in Appendix 7 of this Master' s thesis.

Table 17: Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as an explanatory variable the ESG scores (**14**)

Dependent Variable: Alphas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.072076	0.044233	1.629445	0.1048
ESG scores	-0.001176	0.000713	-1.649814	0.1006

Table 18: Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as an explanatory variable the E scores (**15**)

Dependent Variable: Alphas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.014124	0.029925	0.471984	0.6375
E scores	-0.000224	0.000457	-0.490359	0.6244

Table 19: Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as an explanatory variable the S scores (**16**)

Dependent Variable: Alphas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.064198	0.033209	1.933181	0.0546*
S scores	-0.001088	0.000552	-1.971556	0.0501*

Table 20: Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as an explanatory variable the G scores (**17**)

Dependent Variable: Alphas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.053683	0.047970	1.119107	0.2645
G scores	-0.000857	0.000756	-1.133089	0.2585

Table 21: Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as explanatory variables the E, S and G scores (**18**)

Dependent Variable: Alphas CAPM Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.078603	0.052265	1.503950	0.1342
E scores	0.000261	0.000513	0.508720	0.6115
S scores	-0.001116	0.000639	-1.746791	0.0822*
G scores	-0.000469	0.000808	-0.580556	0.5622

When looking at table 17, we can see that the coefficient related to the ESG scores is negative (-0.001176). The p-value associated to this coefficient is statistically not significant although it is very close to being at the critical threshold of 10%.

In tables 18 and 20, the coefficients related to the environmental and governance scores are also negative but far from being statistically significant.
Interestingly, in table 19, the coefficient inherent in the social criterion appears to be statistically significant at the 10% level. The coefficient's value implies that when firms improve their S criterion by one unit, their risk-adjusted return[148] decreases by -0.001088%.
Finally, if we take a look at table 21, we can observe that, when including the E, S and G factors simultaneously to explain the alphas, that is once again the social score which appears to have an impact on the alphas. Its statistically significant value of -0.001116% is very close to the one obtained in table 19.

This preliminary analysis therefore suggests that companies devoted to enhancing their S score have underperformed the market on a risk adjusted basis. From this fact follows two lines of investigation. The first one is that the performance gap could result from mispricing; financial market participants may so have failed to price social information appropriately. In that case, they would have overvalued the returns attached to socially responsible firms relative to their laggards' counterparts over the year 2018. The second one is the following: given the fact the social criterion affects the risk-adjusted return, one could also suggest that this criterion could eventually be integrated as an additional risk factor to the capital asset pricing model.

Let us now turn to the presentation of the results of the regressions having as a dependent variable the alphas derived from the Fama-French three-factor model.
As previously said, the Fama-French three-factor model is better suited to predict the risk-adjusted expected return in the sense it accounts for two additional risks (SMB and HML). The three-factor alpha is, consequently, also more refined to perform regressions' analysis.

Table 22: Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three-factor model and as an explanatory variable the ESG scores (**14**)

Dependent Variable: Alphas FF 3 factors model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.073680	0.038274	1.925085	0.0557*
ESG scores	-0.001175	0.000617	-1.905338	0.0582*

[148] As a reminder, risk is, in the case of CAPM, captured only through market risk.

Table 23: Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three-factor model and as an explanatory variable the E scores (**15**)

Dependent Variable: Alphas FF 3 factors model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.029037	0.025890	1.121539	0.2634
E scores	-0.000430	0.000395	-1.088911	0.2775

Table 24: Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three-factor model and as an explanatory variable the S scores (**16**)

Dependent Variable: Alphas FF 3 factors model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.048921	0.028878	1.694069	0.0918*
S scores	-0.000802	0.000480	-1.671669	0.0962*

Table 25: Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three-factor model and as an explanatory variable the G scores (**17**)

Dependent Variable: Alphas FF 3 factors model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.054525	0.041561	1.311925	0.1911
G scores	-0.000844	0.000655	-1.288063	0.1992

Table 26: Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three-factor model and as explanatory variables the E, S and G scores (**18**)

Dependent Variable: Alphas FF 3 factors model Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.077754	0.045430	1.711528	0.0886*
E scores	-0.000124	0.000446	-0.277188	0.7819
S scores	-0.000610	0.000555	-1.098113	0.2735
G scores	-0.000513	0.000702	-0.730452	0.4660

When looking at table 22, we can see that the coefficient of the ESG factor is here, contrary to the case of the CAPM analysis, negative and statistically significant at the 10% level. From this table we can say that when firms improve their global ESG score by one point, their risk-adjusted returns decrease by -0.001175%.

If we pay attention to tables 23 and 25, the coefficients of the E and G scores are still negative but once again non statistically significant.

The social criterion's coefficient present in table 24 is still negative (-0.000802) and statistically significant. Given the fact that the global ESG score is simply the equally weighted average of the three individual scores, it can be supposed that it is the S factor which contributes the most to the statistically significance of the ESG global factor in table 22.

Finally, when looking at table 26, all explanatory variables are still negative but none of them is statistically significant. This loss of significance can be explained by the relatively high

correlation' s levels between my E, S and G variables[149]. As I do incorporate in my model variables which appear to be correlated, I deteriorate the quality of precision of it so that standard deviations are higher and, consequently, t-stats lower.

From this analysis, we can observe that two explanatory variables appear to negatively influence the three-factor alphas; the ESG factor and the social factor. The social oriented firms as well as the ESG committed ones do appear to have underperformed the market on a risk-adjusted basis. When analyzing the results linked to the CAPM, we had already identified the social criteria as being statically significant when explaining the alphas while the ESG factor was extremely close to the 10% threshold.

The results of the Fama and French three-factor model being even more reliable than the one of the CAPM, we can therefore suppose, on the on hand that both ESG and S criteria could constitute additional risk factors in traditional asset pricing models or, on the other hand, that stock markets did not fully incorporate value-relevant ESG and S information into the stock prices over the time period under study. In a nutshell, if we believe in market efficiency, the interpretation is that we identify a novel risk factor [e.g., Derwall and Verwijmeren (2007); and Lee and Faff (2009)]. If not, it should be interpreting as systematic mispricing of this set of assets [e.g., Derwall et al (2005); Kempf and Osthoff (2007); Lee and Faff (2009); and Edmans (2011)]

d) Results linked to the core hypothesis of this Master' s thesis

We are now going to the results of the regressions linked to the creation of a 4th factor.

As previously mentioned, I decided to add to the classical Fama and French three-factor model a fourth factor being either an ESG factor, an E factor, a S factor or a G factor.

Before looking at the results attached to those four factor cross-sectional regressions, I found it interesting to calculate the means of the returns attached respectively to the high and low portfolios. This will further strengthen our intuition about the relationship between the average annual return for 2018 and each of the fourth factors.

In addition to that, I represented on a graph the cumulative returns of the high and low sustainable portfolios over the year 2018 (251 days)[150]. This will allow us to have a visual

[149] See table 2 on page 66.

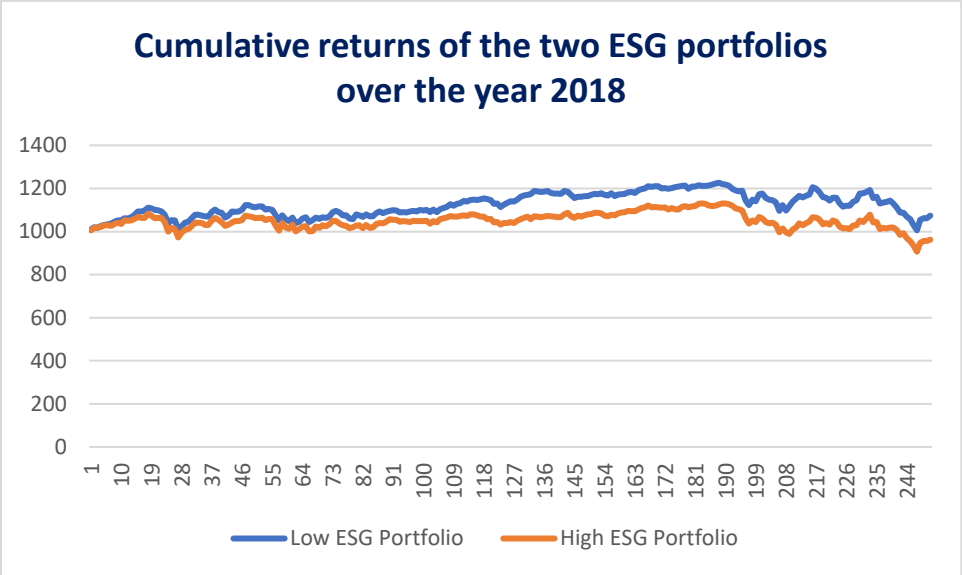
[150] Note that I consider on the graph an initial investment of 1 000 dollars.

representation of the return' gap between the two portfolios under consideration[151].

The means of the returns for the year 2018 take the value of 0.035134398 for the low ESG portfolio and the value of -0.00831737 with respect to the high ESG portfolio. We can identify a positive premium in favor of the low ESG portfolio. This result could reflect a different risk exposure between the two portfolios under consideration. The aforementioned premium is also consistent with the statically significant negative correlation we had observed between R_{i2018} and ESG in table 2.

When looking at graph 1, we clearly see the gap between the low and high ESG portfolios.

Graph 1: Cumulative returns of the two ESG portfolios over the year 2018



Note that those results are also consistent with the way we formed our fourth factor. Fama and French had identified that values stocks as well as small-cap tended to respectively outperform growth and big-cap stocks. Then, in short, they bought their SMB factor by subtracting portfolio returns of big caps from portfolio returns of small caps and their HML factor by subtracting portfolio returns of growth stocks from portfolio returns of value stocks. In a similar vein, we identified that low ESG portfolio returns tend to outperform high ESG portfolio returns and we constructed our fourth factor by subtracting high ESG portfolio returns from low ESG portfolio returns.

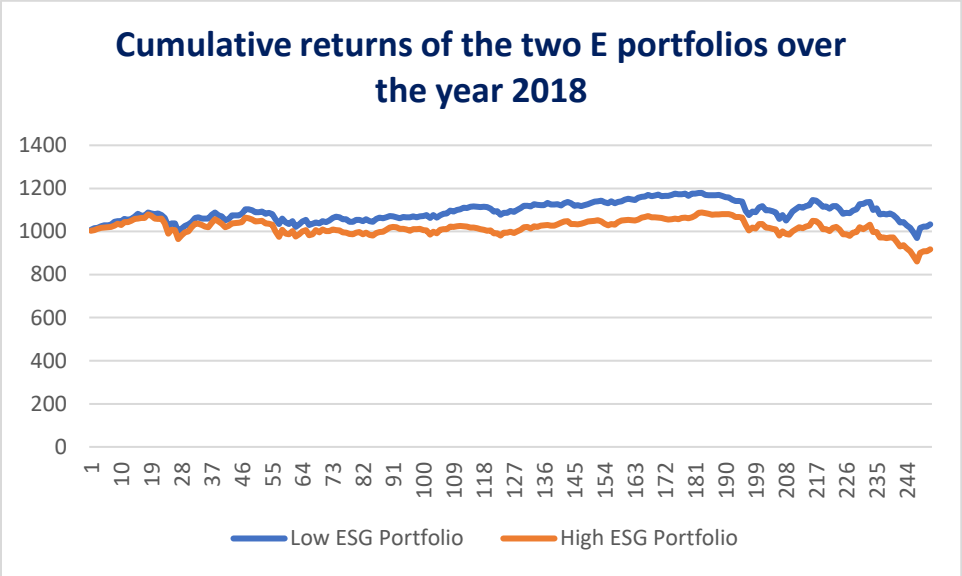
When calculating the returns' mean of the high E portfolio, I get a number of - 0.027684803 while for the low E portfolio I have a value of 0.018421939. Remember that the correlation's

[151] See for instance Görgen et al (2019) who represented also the cumulative returns of BMG and the long and short portfolios.

coefficient between R_{i2018} and E was also negative, although not statistically significant.

Graph 2 once again identifies a so-called premium in favor of the low environmental portfolio.

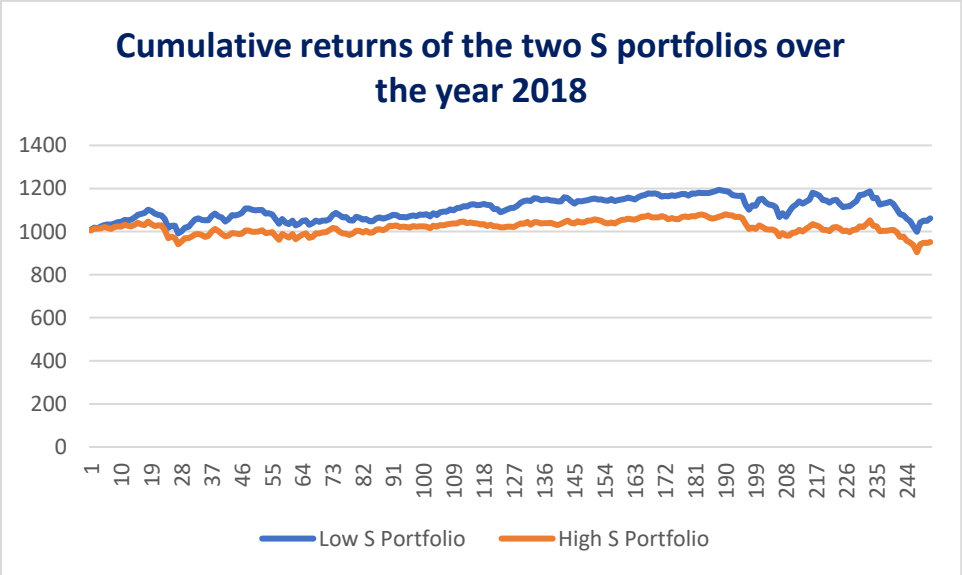
Graph 2: Cumulative returns of the two E portfolios over the year 2018



The mean of the returns of the low S portfolio is 0.029746887 and those of the high S portfolio is - 0.015321905. The related coefficient of correlation present in table 2 was negative and statically significant under the 10% threshold.

Once again, graph 3 allows us to clearly distinguish a gap between the two social portfolios over the 251 days under study.

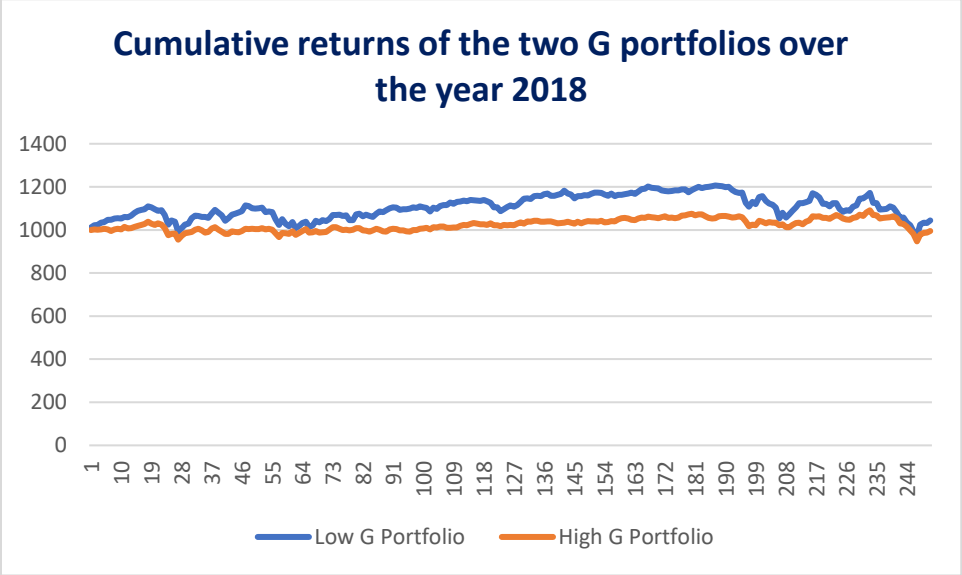
Graph 3: Cumulative returns of the two S portfolios over the year 2018



Finally, when estimating the mean of the returns of the high G portfolio, I get a value of 0.001227719 and a value of 0.026027549 for the low G portfolio. The gap between the low and high portfolios is here lower. Pearson's correlation coefficient was here also negative even though not statically significant.

Thanks to graph 4, we can again visualize the premium inherent in the low governance portfolio.

Graph 4: Cumulative returns of the two G portfolios over the year 2018



Let us finally note that given the fact E, S, and G portfolios share the same properties as the ESG portfolios (ie: return's gap beneficial to the low portfolio), the E, S and G fourth factors were constructed following the same methodology as the one related to ESG.

To justify the econometric procedure used to test the core hypothesis of this Master' s thesis, I will highlight three papers that were key when determining the most appropriate way to operate the creation of a new sustainable risk factor. Note that all of those three papers have been described in detailed in the literature review' part.

The three papers in question are: Halbritter and Dorfleitner (2015)' paper, Jin (2017)' paper and Hübel and Scholz (2019)' paper.

Like me, the first two papers focused on the U.S. and performed times-series as well as cross-sectional investigations. Then, all of the three papers created sustainable risk factors and implemented it in well-known asset pricing models. Finally, the construction of the aforementioned risk factors is also similar to the way I have proceed. Indeed, in the first paper

the author constructed two portfolios (either ESG, E, S or G ones) based on the 20% best and poorest sustainable firms. In a similar vein, we investigated both global as well as individual scores and we took the best/poorest deciles of sustainable firms' ranking. The last paper forms its sustainable risk factor taking a long position in firms with low sustainable ratings and a short one in firms with high sustainable ratings, exactly as we did.

Let us now investigate in depth the results linked to equations 23, 24, 25 and 26. Note once again, that all tables presented in this section are available in their entirety in Appendix 9 of this Master' s thesis.

Table 27: Cross-sectional regression having as a dependent variable the average annual returns and as explanatory variables the estimated betas related to Rm-Rf, SMB, HML and ESG (**23**)

Dependent Variable: Average annual returns in 2018 Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	-0,005062	0,017356	-0,291660	0,7709
$\widehat{ß}_{im}$	-0,004689	0,016751	-0,279933	0,7798
$\widehat{ß}_{is}$	-0,028861	0,021092	-1,368343	0,1728
$\widehat{ß}_{ih}$	-0,067131	0,008368	-8,022654	0,0000***
$\widehat{ß}_{iESG}$	0,057837	0,011552	5,006473	0,0000***

If we pay attention to the results of this final regression, we mainly have to note that the coefficient of $ß_{iesg}$ has a positive value of 0.057837. This is consistent with respect to the related risk factor; we indeed expected risk to be at the level of low ESG firms and thus a premium in favor of those companies.

Most importantly, this result is highly statistically significant. The p-value of 0.0000 indeed satisfies the three boundaries of statistical significance; namely the border of 10%, that of 5%, but also that of 1%. From this table, it thus seems that we have identified a 4th risk factor; namely an ESG factor.

Importantly, our result is consistent with the one of Jin (2017) who bought its ESG-related factor the same way we did it and also discovered a significant positive ESG risk premium. Our result is also consistent with the findings of Girerd-Potin et al (2014) who showed that investors ask for an additional risk premium when they agree to hold low CSR stocks.

In order to explain such a result, various plausible explanations can be advanced.

Firstly, Merton (1987)' s capital market equilibrium model suggests that when the size of a firm' s investor base increases, its cost of equity capital will in turn diminish. Because the fewer

the investors, the lower the opportunities for stockholding risk to be diversified. A weak demand for stocks having lower sustainable scores will thus lead to higher risk because investors require additional premiums as a compensation for the lack of risk sharing opportunities (Heinkel et al (2001)). Firms with better sustainable ratings usually having a larger base of investors either because of investors' preferences or reduced information asymmetry (El Ghoul et al (2011)). On the one hand, Brammer et al (2006) and Girerd-Potin et al (2014) especially showed that investors are not motivated purely by financial returns and have the tendency to accept a financial sacrifice to *"improve the world"*. On the other hand, information asymmetry is likely to be more severe for low sustainable firms. Indeed, Dhaliwal et al (2011) showed empirically that high sustainable firms tend to disclose more information, as these firms want to project their positive image as a responsible corporate citizen to investors and other stakeholders. Moreover, Hong and Kacperczyk (2009) found that *"sin"* companies receive less coverage from analysts, which implies that analysts and the media are more inclined to spend time analyzing and reporting news about *"good"* firms. Finally, when information reaches investors, socially conscious investors are likely to pay more attention to information related to high sustainable firms while neglecting information related to low sustainable firms. Overall, the relative size of a low sustainable firm's investor base is lower and, consequently, its equity capital cost higher.

Secondly, we can consider agency theory which advocates that there exists an information asymmetry between the agent (i.e.: the manager) and the principal (i.e.: the shareholder). As a consequence, the agent may not always act in the best interest of the principal. Given the fact that firms with higher ESG ratings tend to disclose more information about their financial and extra-financial activities, the information asymmetry is thus attenuated, and equity cost is then reduced [e.g., Dhaliwal et al (2011); and Cui et al (2016)].

Thirdly, ESG firms tend to reduce the variability of cash flows. For instance, investments in ESG help develop a company' s capabilities and processes, and in particular might induce a forward-looking corporate culture, which increases the company' s resilience to business cycles and economic shocks (Orlitzky et al (2003)). Such resilience to negative news might also stem from the consumer loyalty of socially responsible consumers who more strongly identify with ESG companies (Sen and Bhattacharya (2001)). Firms that are responsive to product quality and customer needs may also be less likely to encounter product liability suits and costly settlements while environmentally responsive firms are less likely to be subjected to

environmental fines and lawsuits (Sauer (1997)). Shareholders may require lower return from sustainable firms which are considered as less risky due to their higher commitment to legal and regulatory rules. By reducing the number of potential claimants on its rents, more of the firm's overall economic resources can in fact be directed strategically to dividends to stockholders, internal investments, acquisitions, etc. Each of these activities is likely to be rewarded by the market in terms of improved risk perception of the firm from an investment standpoint.

Finally, good corporate citizenship is also likely to create solid firm trust, reputation, brand and loyalty. As a result, responsible firms may experience increased product sales. This again could reduce investors' risk perception towards such kinds of companies. The benefits of good corporate citizenship need not end with the customer, rather, a firm which cares about employee satisfaction and wellbeing may also be in a better position to attract and retain good employees. Advocates of social-responsibility investing argue that employee loyalty benefits a firm by improving productivity, innovation, lowering production costs, and thereby enhancing profitability (McGuire et al (1988)). On the environmental side, firms which minimize the negative environmental impacts of their products and processes, recycle post-consumer waste, and establish environmental management systems reduce costs from materials waste, energy consumption and inefficient processes and prevent environmental spills or even management time directed at clean-up and remediation. Green firms are also more prone to attract customers and expand their markets or displace competitors that fail to promote strong environmental performance (Salama et al 2011).

All in all, those underlined facts would once again lead to a reduced required return towards socially responsible firms considered as potentially more profitable, reliable and suited to future development.

The four aforementioned arguments imply that, *ceteris paribus*, high ESG firms have lower costs of equity capital than their low counterparts (El Ghoul et al (2011)). This reasoning is in line with results obtained in the fourth tables of this section.

Let us now investigate the results obtained when specifically creating an environmental, social or governance fourth factor.

Table 28: Cross-sectional regression having as a dependent variable the average annual returns and as explanatory variables the estimated betas related to Rm-Rf, SMB, HML and E (**24**)

Dependent Variable: Average annual returns in 2018 Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.026341	0.019342	-1.361841	0.1748
$\widehat{ß}_{im}$	0.009712	0.018216	0.533157	0.5945
$\widehat{ß}_{is}$	-0.046246	0.022142	-2.08863	0.0380**
$\widehat{ß}_{ih}$	-0.067065	0.008515	-7.875726	0.0000***
$\widehat{ß}_{iE}$	0.046097	0.012114	3.805235	0.0002***

If we look at the environmental aspect, we most importantly have to highlight that the coefficient attached to $\widehat{ß}_{iE}$ is also positive and highly statistically significant.

From this table, we can advance that the environmental factor can also be considered as a specific risk factor on its own.

Interestingly our result is once again consistent with another paper; the one of Görgen et al (2019) who developed a carbon risk factor and underlined its relevance as an additional risk factor in an asset pricing perspective.

Table 29: Cross-sectional regression having as a dependent variable the average annual returns and as explanatory variables the estimated betas related to Rm-Rf, SMB, HML and S (**25**)

Dependent Variable: Average annual returns in 2018 Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010910	0.017521	0.622715	0.5342
$\widehat{ß}_{im}$	-0.022650	0.016831	-1.345699	0.1800
$\widehat{ß}_{is}$	-0.024571	0.021185	-1.159825	0.2475
$\widehat{ß}_{ih}$	-0.068238	0.008409	-8.114814	0.0000***
$\widehat{ß}_{iS}$	0.063062	0.012189	5.173739	0.0000***

The social criterion also seems to be an important risk factor; its p-value is extremely significant, and its related premium is the highest among the four regressions presented in this section[152].

Interestingly, the premiums attached to the ESG and S factors are much higher compared to the one of the E and G factors. The ESG and S p-values are also in both cases equal to 0. We could link those results to the results highlighted at the very end of the section dedicated to the development of the Fama-French risk-adjusted returns. From this analysis, we notified that ESG and S factors significantly negatively influenced the alphas[153]. Considering the market

[152] The coefficient attached to the $\widehat{ß}_{iS}$ risk factor (0.063062) is indeed the largest among the four regressions performed.
[153] See tables 22 and 24 on pages 79 and 80.

as efficient, those results suggested that specific ESG and S factors could be added to the three traditional risk factors. By transforming this information into new risk factors[154] in the classical Fama-French model, we indeed see that their related premium are high and highly statistically significant.

Table 30: Cross-sectional regression having as a dependent variable the average annual returns and as explanatory variables the estimated betas related to Rm-Rf, SMB, HML and G (**26**)

Dependent Variable: Average annual returns in 2018 Included observations: 200				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	0.037827	0.025250	1.498090	0.1357
$\widehat{ß}_{im}$	-0.050232	0.024792	-2.026111	0.0441
$\widehat{ß}_{is}$	-0.030721	0.021896	-1.403051	0.1622
$\widehat{ß}_{ih}$	-0.068093	0.008678	-7.846729	0.0000***
$\widehat{ß}_{iG}$	0.019953	0.011386	1.752373	0.0813*

Finally, we just have to analyze the governance criterion. Once again, the premium attached to the fourth factor is positive and statistically significant although it is the lowest of the four sustainable premiums. Moreover, the premium here only holds under the 10% threshold. The fact that the premium of the governance factor is the lowest and that its p-value is the highest[155] could partially be explained by the fact that this factor already had an extremely significant impact on the market beta, as notified in tables 10 and 15.
Interestingly, the results achieved throughout this study with respect to the governance criterion are consistent with those of Ashbaugh et al (2004) who shed in light that governance affects equity cost both directly (fourth factor) and indirectly (market beta).

Overall, our results are also consistent with Hübel and Scholz (2019) who indicated that the E factor, the S one as well as the G one contribute to the explanatory power of traditional pricing models.

For information, relatively to the fact that the coefficient attached to the estimated HML risk factor is in each case statistically significant, it can be deduced that this variable has an important role when explaining the average annual return in my sample. When looking at correlation tables available in Appendix 10, we can see that this factor has relatively low correlations with respect to the three other ones. This reinforces all the more the predictive character of this factor. The coefficient attached to it is always negative, whatever the fourth

[154] In this particular case, a factor ESG or S.
[155] Among the four 4th factors created.

factor considered. It is thus obvious that my sample has a tilt towards growth stocks during the period examined.

When considering the market-risk premia, those are in neither case statistically significant. To explain such a result, it is once again important to look at the four correlation tables and to note the extremely strong correlation this factor has particularly with the SMB factor. This causes a loss of precision in our four specifications and it thus systematically lowers t-stats for these two variables.

Conclusion

Dealing with environmental, social, and governance (ESG) issues is increasingly expected of firms to succeed in today's world. Megatrends such as climate change, population growth and natural resources' disappearance create risks that require companies to deal with ESG issues in a serious way. In such a changing environment, many academic papers have investigated what the consequences of responsible investing are for firms and investors. The main question has been whether sustainable investing pays off in one way or another. With that respect, research has especially been conducted to show the impact ESG commitment has on a firm' s cost of equity capital. Facing such a question, most of scholars reached the conclusion that "*Companies embracing ESG criteria face lower equity cost*".

In line with these studies, I essentially performed OLS regressions which look at the relevance of incorporating ESG criteria from a company perspective and focus on the cost of equity.

In a more detailed way, I first investigated the potential impact sustainability has on well-known market betas and risk-adjusted returns. With that respect, I found that environmentally friendly firms face a higher systematic risk than firms having poor environmental scores while well-governed companies enjoy a lower systematic risk than poorly governed companies. Looking at risk-adjusted returns enables us, on the one hand, to inform investors about the apparent risk-adjusted underperformance of social and ESG firms compared to the market and, on the other hand, to consider (under the hypothesis of market efficiency) an omitted sustainable risk factor in an asset pricing perspective.

After such preliminary analyses, I investigated the key question of this Master' s thesis, that is: "*Does it make sense to incorporate an ESG risk factor in the traditional FF equity pricing model?*". To answer this question, I have constructed four different ESG risk factors (ESG, E, S and G) to quantify the sustainable risk exposures of firms. Thanks to the construction of those sustainable risk factors and the addition of them into the famous Fama-French three-factor model, I found that market participants charge a statistically significant higher sustainable risk premiums to firms having poor sustainable scores. Those new factors thus appear to push upward the equity cost of non-green companies. As a whole, ESG criteria therefore appear to be relevant to investors and financial markets look like rewarding ESG performance.

Such a result could be explained by both investor base and risk channels. The first channel essentially says that unsustainable firms have a restricted investor base due to investor preferences for green companies as well as a higher information asymmetry. Poor sustainable companies thus have to offer their shareholders higher expected returns to compensate them for the lack of risk sharing. The second channel, that is, the risk one, advances that higher returns might be a premium that investors earn for the displeasure of holdings poor sustainable stocks, possibly as a compensation for the additional risks these stocks exhibit. The lower risk inherent in high ESG firms can happen because they have happier, more stable employees, lower fines, good production levels, and all the other business-related virtues bestowed on leading ESG firms.

Notwithstanding, this study is obviously not free from certain limitations. One of the most important failures of this Master' s thesis is that it is limited to the year 2018; such a short period of time may indeed easily induce biased results. Moreover, my sample is limited to two thousand companies. It could be argued it is too restrictive to draw reliable results when performing regressions.

The results of this study also suggest some other aspects might be worth considering for future research. Firstly, it would be wise to use ESG data from another data provider (For example, Bloomberg or Thomson Reuters). Indeed, and as underlined by Halbritter and Dorfleitner (2015), most papers focus on one special ESG rating database, but it is possible that implications related to returns are dependent on the underlying rating approach. Secondly, in this paper we focus on the US context, but it might be fruitful to extend the study to other contexts. As an example, given that Europe accounts for over half of the assets managed sustainably worldwide according to Global Sustainable Investment Alliance GSIA (2017), it would be very interesting to replicate the study using European data. Thirdly, it would be interesting to reproduce the same econometric manipulations performed in this Master' s thesis under another pricing model to see if our core results still hold under another pricing specification (For example, to add the sustainable fourth factor in the Fama-French five-factor model). Finally, it would be wise to check endogeneity issues. For example, it would be wise to extend the time period under study in order to investigate the reverse causality of my key result, that is: "*Do firms with low equity costs spend more money to enhance their ESG performance?*".

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Appendices

Appendix 1: Detailed description of some concepts discussed in this work

- The UN Global Compact

The UN Global Compact is the world's largest corporate sustainability initiative. It is in fact a voluntary initiative based on CEO commitments to implement universal sustainability principles and to take steps to support UN goals. Gathering 34 participants on July 26, 2000, the initiative now has more than 13,000 signatories in over 160 countries, both developed and developing, representing nearly every sector and size.

- The United Nations backed Principles for Responsible Investment (UN PRI)

The United Nations-supported Principles for Responsible Investment (PRI) Initiative is an international network of investors working together to put the six Principles for Responsible Investment into practice. Its goal is to understand the implications of sustainability for investors and support signatories to incorporate these issues into their investment decision making and ownership practices. In implementing the Principles, signatories contribute to the development of a more sustainable global financial system. With 90 participants at the end of 2006, the UN PRI no gathers more than 2,300 signatories.

- The Global Reporting Initiative (GRI)

GRI is an independent international organization that has pioneered sustainability reporting since 1997. GRI helps businesses and governments worldwide understand and communicate their impact on critical sustainability issues such as climate change, human rights, governance and social well-being. This enables real action to create social, environmental and economic benefits for everyone. The GRI Sustainability Reporting Standards are developed with true multi-stakeholder contributions and rooted in the public interest.

- The Carbon Disclosure Project (CDP)

CDP is a not-for-profit charity that runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts. Over the past 15 years it has created a system that has resulted in unparalleled engagement on environmental issues worldwide. There are now companies, cities, states and regions from over 90 countries that disclose through CDP.

- **T**he Sustainability Accounting Standards Board (SASB)

SASB was founded in 2011 by Jean Rogers, who originated the concept and served as the organization's first CEO. SASB is a non-profit that seeks to create industry sustainability standards for the disclosure and recognition of financially material environmental, social, and governance impacts of publicly traded US companies.

- The European Sustainable Investment Forum (Eurosif)

The European Sustainable Investment Forum is a European network dedicated to promoting the integration of ESG criteria into financial management, mainly through lobbying European institutions, publishing research reports and organizing events for raise investor awareness of ESG issues. Eurosif is a non-profit organization that was founded in 2001 to promote Socially Responsible Investment throughout Europe. It is the European reference organization for the development of responsible investment practices.

Appendix 2: Meta-studies, reports and literature reviews on CP and sustainability

Meta-studies

Sampling 52 US empirical studies that span 30 years of research, Orlitzky et al (2003) demonstrated namely that corporate social performance and financial performance are generally positively related across a wide variety of industry and study contexts. They also put in light that there is a kind of virtuous cycle (so, a bidirectional causality) between corporate social performance and financial performance[156]. Margolis et al (2007) analyzed 167 studies from 1972 through 2007 and concluded that there is a mildly positive relationship between corporate social performance (CSP) and corporate financial performance (CFP). Gossling and Van Beurden (2008) evaluated 34 studies which investigate corporate social and financial performance. Among them, 68% find a positive relationship between CSP and CFP, 26% show no significant relationship and 6% show a negative relationship. Russell Crook et al (2011) investigated 66 studies through their so called "*human capital and firm performance meta-analysis*". Overall, their results suggest that human capital relates strongly to performance. More recently, Friede et al (2015) investigated more than 2200 empirical studies. Hence, this paper is by far the most exhaustive overview of academic research on this subject. The authors found that the business case for ESG investing is empirically very well founded. Indeed, roughly 90% of studies find a nonnegative ESG–CFP relation. Most importantly, the vast majority of studies reports positive findings. In the same year, Oxford University and Arabesque Partners published a meta-study called *"From the Stockholder to the Stakeholder; How Sustainability Can Drive Financial Outperformance"*. This meta-study categorized more than 200 sources, including academic studies, industry reports, newspaper articles and books. Relatively to sustainability and its relation to financial market performance, 80% of their studies document a positive correlation between good sustainability and superior financial market performance while 88% of the research shows that solid ESG practices result in better operational performance of firms.

[156] The relationship tends so to be bidirectional and simultaneous.

Reports and literature reviews

"*Sustainable Investing: Establishing Long-Term Value and Performance*" is an important literature review which was done by DB Climate Change Advisors in 2012. The authors performed one of the most comprehensive reviews of the literature ever undertaken. One of the main conclusions they reached is that ESG criteria go hand in hand with superior risk-adjusted returns at a securities level. In 2007, Mercer published "*Demystifying Responsible Investment Performance*", a joint report with the AMWG UNEP FI[157]. This report highlighted 20 papers examining the relation between ESG issues and financial performance. In 2009, Mercer issued another report *("Shedding Light on Responsible Investment: Approaches, Returns and Impacts"*), in which he reviewed a further 16 academic studies on ESG and financial performance that were published after the AMWG UNEP FI/Mercer joint report. Pooling those results with the 2007 report, there are 36 studies in total: 20 studies highlighting a positive relation, 2 showing evidence of a neutral/positive relation, 3 reaching the conclusion of a negative/neutral relation, 8 showing a neutral relation and only 3 clearly indicating a negative relation. In July 2017, Nuveen TIAA Investments released a report called *"Responsible Investing: Delivering Competitive Performance"*. The authors selected five widely known U.S. equity RI indexes with track records of at least 10 years[158] as well as two famous U.S. equity-based indexes[159]. As a whole, they found no statistical difference in RI index returns compared to the two broad market benchmarks. Moreover, with standard deviations of returns and Sharpe ratios comparable between RI indexes and benchmarks, this suggests that incorporating ESG criteria in investment decisions does not require taking on additional risk relative to broad market benchmarks.

[157] Asset Management Working Group of the United Nations Environment Programme Finance Initiative.
[158] The Calvert U.S. Large Cap Core Responsible Index, the Dow Jones Sustainability U.S. Index, the FTSE4Good US Index, the MSCI KLD 400 Social Index and the MSCI USA IMI ESG Leaders Index.
[159] The Russell 3000 and S&P 500 indexes.

Appendix 3: Overview of the two thousand companies belonging to the sample

Enterprise	Sector
1. Oneok	Energy
2. TE Connectivity	Technology
3. Moody's	Financial Services
4. Waste Management	Industrials
5. Micron Technology	Technology
6. Regeneron Pharmaceuticals	Healthcare
7. Norfolk Southern	Industrials
8. Schlumberger	Energy
9. 3M	Industrials
10. AT&T	Communication Services
11. Visa	Financial Services
12. Walt Disney	Consumer Cyclical
13. Coca-Cola	Consumer Defensive
14. Home Depot	Consumer Cyclical
15. PepsiCo	Consumer Defensive
16. Philip Morris International	Consumer Defensive
17. Gilead Sciences	Healthcare
18. U.S. Bancorp	Financial Services
19. ConocoPhillips	Energy
20. Caterpillar	Industrials
21. CVS Health	Healthcare
22. Amazon	Consumer Cyclical
23. Microsoft	Technology
24. Apple	Technology
25. Berkshire Hathaway	Financial Services
26. Facebook	Technology
27. Johnson & Johnson	Healthcare
28. JPMorgan Chase	Financial Services
29. Exxon Mobil	Energy
30. Bank of America	Financial Services
31. Pfizer	Healthcare
32. Procter & Gamble	Consumer Defensive
33. Wells Fargo & Company	Financial Services
34. Chevron	Energy
35. Verizon Communications	Communication Services
36. Intel	Technology
37. Mastercard	Financial Services
38. Boeing	Industrials
39. Cisco Systems	Technology
40. Merck & Co	Healthcare
41. Oracle	Technology
42. Comcast	Communication Services
43. Citigroup	Financial Services
44. Netflix	Consumer Cyclical
45. McDonald's	Consumer Cyclical
46. Nike	Consumer Cyclical
47. Eli Lilly	Healthcare
48. Abbott Laboratories	Healthcare
49. DowDuPont	Basic Materials

50. IBM	Technology
51. AbbVie	Healthcare
52. Adobe	Technology
53. Salesforce	Technology
54. Amgen	Healthcare
55. Medtronic	Healthcare
56. Union Pacific	Industrials
57. Broadcom	Technology
58. Honeywell International	Industrials
59. PayPal Holdings	Financial Services
60. United Technologies	Industrials
61. Accenture	Technology
62. Thermo Fisher Scientific	Healthcare
63. Texas Instruments Incorporated	Technology
64. Costco Wholesale	Consumer Defensive
65. Altria Group	Consumer Defensive
66. General Electric	Industrials
67. NVIDIA	Technology
68. American Express	Financial Services
69. Booking Holdings	Consumer Cyclical
70. NextEra Energy	Utilities
71. Starbucks	Consumer Cyclical
72. Lockheed Martin	Industrials
73. Bristol-Myers Squibb	Healthcare
74. Anthem	Healthcare
75. Charter Communications	Communication Services
76. Lowe's Companies	Consumer Cyclical
77. Danaher	Healthcare
78. American Tower	Communication Services
79. Cigna	Healthcare
80. The Goldman Sachs Group	Financial Services
81. Morgan Stanley	Financial Services
82. Walgreens Boots Alliance	Consumer Defensive
83. Biogen	Healthcare
84. Becton, Dickinson and Company	Healthcare
85. Stryker	Healthcare
86. Mondelez International	Consumer Defensive
87. Blackrock	Financial Services
88. Charles Schwab	Financial Services
89. Duke Energy	Utilities
90. Automatic Data Processing	Industrials
91. Chubb	Financial Services
92. Celgene	Healthcare
93. The TJX Companies	Consumer Cyclical
94. Qualcomm	Technology
95. Intuitive Surgical	Healthcare
96. Simon Property Group	Real Estate
97. Kraft Heinz	Consumer Defensive
98. EOG Resources	Energy
99. The PNC Financial Services Group	Financial Services
100. Intuit	Technology
101. CSX	Industrials
102. Colgate-Palmolive	Consumer Defensive
103. Dominion Energy	Utilities
104. General Motors	Consumer Cyclical

105. Deere & Company	Industrials
106. Boston Scientific	Healthcare
107. Bank of New York Mellon	Financial Services
108. General Dynamics	Industrials
109. Occidental Petroleum	Energy
110. Southern	Utilities
111. Raytheon	Industrials
112. The Estée Lauder Companies	Consumer Defensive
113. Crown Castle International	Real Estate
114. S&P Global	Financial Services
115. Vertex Pharmaceuticals	Healthcare
116. FedEx	Industrials
117. Northrop Grumman	Industrials
118. Allergan	Healthcare
119. Marsh & McLennan companies	Financial Services
120. Ecolab	Basic Materials
121. Illinois Tool Works	Industrials
122. Exelon	Utilities
123. MetLife	Financial Services
124. Intercontinental Exchange	Financial Services
125. Prologis	Real Estate
126. Zoetis	Healthcare
127. Emerson Electric	Industrials
128. Humana	Healthcare
129. Illumina	Healthcare
130. Cognizant Technology Solutions	Technology
131. Kinder Morgan	Energy
132. Carnival	Consumer Cyclical
133. Marriott International	Consumer Cyclical
134. Sherwin-Williams	Basic Materials
135. American Electric Power	Utilities
136. Prudential Financial	Financial Services
137. Baxter International	Healthcare
138. Capital One Financial	Financial Services
139. Target	Consumer Defensive
140. BB&T	Financial Services
141. Applied Materials	Technology
142. Analog Devices	Technology
143. Air Products & Chemicals	Basic Materials
144. Aflac Incorporated	Financial Services
145. Activision Blizzard	Technology
146. Valero Energy	Energy
147. Public Storage	Real Estate
148. Fidelity National Information Services	Industrials
149. Edwards Lifesciences	Healthcare
150. HP	Technology
151. Ford Motor	Consumer Cyclical
152. Delta Air Lines	Industrials
153. Ross Stores	Consumer Cyclical
154. Sysco	Consumer Defensive
155. Fiserv	Industrials
156. Lyondellbasell Industries	Basic Materials
157. Eaton	Industrials
158. The Travelers Companies	Financial Services
159. Autodesk	Technology

160. The Williams Companies	Energy
161. Southwest Airlines	Industrials
162. eBay	Consumer Cyclical
163. Sempra Energy	Utilities
164. Monster Beverage	Consumer Defensive
165. Equinix	Real Estate
166. Red Hat	Industrials
167. Johnson Controls International	Industrials
168. Roper Technologies	Industrials
169. Allstate	Financial Services
170. Dollar General	Consumer Defensive
171. Welltower	Real Estate
172. Halliburton	Energy
173. Xilinx	Technology
174. Electronic Arts	Technology
175. Royal Caribbean Cruises	Consumer Cyclical
176. Public Service Enterprise Group Incorporated	Utilities
177. Alexion Pharmaceuticals	Healthcare
178. Amphenol	Technology
179. Equity Residential	Real Estate
180. Xcel Energy	Utilities
181. AvalonBay Communities	Real Estate
182. Corning Incorporated	Technology
183. General Mills	Consumer Defensive
184. SunTrust Banks	Financial Services
185. Lam Research	Technology
186. Paychex	Industrials
187. IQVIA Holdings	Healthcare
188. Fortive	Technology
189. PPP Industries	Basic Materials
190. Ingersoll-Rand	Industrials
191. Republic Services	Industrials
192. McKesson	Healthcare
193. Zimmer Biomet Holdings	Healthcare
194. Agilent Technologies	Healthcare
195. United Continental Holdings	Industrials
196. Cummins	Industrials
197. WEC Energy Group	Utilities
198. Twenty-First Century Fox	Consumer cyclical
199. Alphabet	Technology
200. Centene	Healthcare

Appendix 4: Cross-sectional regressions having as a dependent variable the average annual returns for the year 2018 and, as an independent variable, sustainable data

Equation used to run cross-sectional regressions having as a dependent variable the average 2018 returns (R_{i2018}) and, as an independent variable, the ESG scores (Equation 2)

Dependent Variable: RI_2018
Method: Least Squares
Date: 06/07/19 Time: 17:46
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.056960	0.042432	1.342379	0.1810
ESG	-0.001141	0.000684	-1.668396	0.0968

R-squared	0.013863	Mean dependent var	-0.013217
Adjusted R-squared	0.008883	S.D. dependent var	0.079354
S.E. of regression	0.079001	Akaike info criterion	-2.228767
Sum squared resid	1.235744	Schwarz criterion	-2.195784
Log likelihood	224.8767	Hannan-Quinn criter.	-2.215419
F-statistic	2.783544	Durbin-Watson stat	1.883671
Prob(F-statistic)	0.096818		

Equation used to run cross-sectional regressions having as a dependent variable the average 2018 returns (R_{i2018}) and, as an independent variable, the E scores (Equation 3)

Dependent Variable: RI_2018
Method: Least Squares
Date: 06/07/19 Time: 17:46
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005633	0.028696	0.196289	0.8446
E	-0.000293	0.000438	-0.669854	0.5037

R-squared	0.002261	Mean dependent var	-0.013217
Adjusted R-squared	-0.002778	S.D. dependent var	0.079354
S.E. of regression	0.079464	Akaike info criterion	-2.217070
Sum squared resid	1.250283	Schwarz criterion	-2.184087
Log likelihood	223.7070	Hannan-Quinn criter.	-2.203722
F-statistic	0.448704	Durbin-Watson stat	1.888859
Prob(F-statistic)	0.503731		

Equation used to run cross-sectional regressions having as a dependent variable the average 2018 returns (R_{i2018}) and, as an independent variable, the S scores (Equation 4)

Dependent Variable: RI_2018
Method: Least Squares
Date: 06/07/19 Time: 17:45
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.048316	0.031864	1.516307	0.1310
S	-0.001039	0.000530	-1.961322	0.0512

R-squared	0.019058	Mean dependent var	-0.013217
Adjusted R-squared	0.014104	S.D. dependent var	0.079354
S.E. of regression	0.078792	Akaike info criterion	-2.234048
Sum squared resid	1.229235	Schwarz criterion	-2.201065
Log likelihood	225.4048	Hannan-Quinn criter.	-2.220701
F-statistic	3.846786	Durbin-Watson stat	1.910296
Prob(F-statistic)	0.051243		

Equation used to run cross-sectional regressions having as a dependent variable the average 2018 returns (R_{i2018}) and, as an independent variable, the G scores (Equation 5)

Dependent Variable: RI_2018
Method: Least Squares
Date: 06/07/19 Time: 17:45
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.021860	0.046104	0.474160	0.6359
G	-0.000557	0.000727	-0.766557	0.4443

R-squared	0.002959	Mean dependent var	-0.013217
Adjusted R-squared	-0.002077	S.D. dependent var	0.079354
S.E. of regression	0.079436	Akaike info criterion	-2.217770
Sum squared resid	1.249409	Schwarz criterion	-2.184787
Log likelihood	223.7770	Hannan-Quinn criter.	-2.204422
F-statistic	0.587610	Durbin-Watson stat	1.915799
Prob(F-statistic)	0.444258		

Appendix 5: Example of the CAPM and Fama-French three-factor time-series regressions' results obtained for a given company (Abbott Laboratories)

CAPM (Equation 7)

Dependent Variable: EXCESS_RET_AL
Method: Least Squares
Date: 03/02/19 Time: 15:32
Sample: 1 251
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.120261	0.053094	2.265055	0.0244
RM_RF__251_OBSERVATIONS_	1.044367	0.048842	21.38238	0.0000

R-squared	0.647412	Mean dependent var	0.097335
Adjusted R-squared	0.645996	S.D. dependent var	1.413482
S.E. of regression	0.840997	Akaike info criterion	2.499479
Sum squared resid	176.1117	Schwarz criterion	2.527570
Log likelihood	-311.6846	Hannan-Quinn criter.	2.510784
F-statistic	457.2063	Durbin-Watson stat	1.829038
Prob(F-statistic)	0.000000		

Fama and French three-factor model (Equation 8)

Dependent Variable: EXCESS_RET_AL
Method: Least Squares
Date: 03/02/19 Time: 15:33
Sample: 1 251
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.104208	0.052377	1.989576	0.0477
RM_RF__251_OBSERVATIONS_	0.991514	0.051815	19.13558	0.0000
SMB__251_OBSERVATIONS_	-0.301214	0.102321	-2.943808	0.0036
HML__251_OBSERVATIONS_	-0.259528	0.102096	-2.542000	0.0116

R-squared	0.663135	Mean dependent var	0.097335
Adjusted R-squared	0.659044	S.D. dependent var	1.413482
S.E. of regression	0.825352	Akaike info criterion	2.469795
Sum squared resid	168.2580	Schwarz criterion	2.525978
Log likelihood	-305.9593	Hannan-Quinn criter.	2.492405
F-statistic	162.0775	Durbin-Watson stat	1.823024
Prob(F-statistic)	0.000000		

Appendix 6: Tables of the cross-sectional regressions having as a dependent variable the market betas and, as an independent variable, the sustainable data

Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as an explanatory variable the ESG scores (Equation 9)

Dependent Variable: BETA_CAPM
Method: Least Squares
Date: 04/01/19 Time: 11:16
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.898510	0.183158	4.905644	0.0000
ESG_SCORES	0.000327	0.002952	0.110851	0.9118

R-squared	0.000062	Mean dependent var	0.918637
Adjusted R-squared	-0.004988	S.D. dependent var	0.340162
S.E. of regression	0.341009	Akaike info criterion	0.696133
Sum squared resid	23.02484	Schwarz criterion	0.729117
Log likelihood	-67.61334	Hannan-Quinn criter.	0.709481
F-statistic	0.012288	Durbin-Watson stat	1.867876
Prob(F-statistic)	0.911847		

Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as an explanatory variable the E scores (Equation 10)

Dependent Variable: BETA_CAPM
Method: Least Squares
Date: 04/01/19 Time: 11:17
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.679905	0.121927	5.576312	0.0000
E_SCORES	0.003717	0.001861	1.996638	0.0472

R-squared	0.019737	Mean dependent var	0.918637
Adjusted R-squared	0.014786	S.D. dependent var	0.340162
S.E. of regression	0.337637	Akaike info criterion	0.676261
Sum squared resid	22.57181	Schwarz criterion	0.709245
Log likelihood	-65.62613	Hannan-Quinn criter.	0.689609
F-statistic	3.986563	Durbin-Watson stat	1.884696
Prob(F-statistic)	0.047234		

Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as an explanatory variable the S scores (Equation 11)

Dependent Variable: BETA_CAPM
Method: Least Squares
Date: 04/01/19 Time: 11:18
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.959430	0.137879	6.958482	0.0000
S_SCORES	-0.000689	0.002292	-0.300493	0.7641

R-squared	0.000456	Mean dependent var	0.918637
Adjusted R-squared	-0.004592	S.D. dependent var	0.340162
S.E. of regression	0.340942	Akaike info criterion	0.695740
Sum squared resid	23.01578	Schwarz criterion	0.728723
Log likelihood	-67.57396	Hannan-Quinn criter.	0.709087
F-statistic	0.090296	Durbin-Watson stat	1.863742
Prob(F-statistic)	0.764117		

Cross sectional regression having as a dependent variable the betas derived from the CAPM and as an explanatory variable the G scores (Equation 12)

Dependent Variable: BETA_CAPM
Method: Least Squares
Date: 04/01/19 Time: 11:19
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.698942	0.189873	8.947772	0.0000
G_SCORES	-0.012391	0.002993	-4.140455	0.0001

R-squared	0.079683	Mean dependent var	0.918637
Adjusted R-squared	0.075035	S.D. dependent var	0.340162
S.E. of regression	0.327151	Akaike info criterion	0.613158
Sum squared resid	21.19146	Schwarz criterion	0.646141
Log likelihood	-59.31579	Hannan-Quinn criter.	0.626506
F-statistic	17.14337	Durbin-Watson stat	1.868853
Prob(F-statistic)	0.000051		

Cross-sectional regression having as a dependent variable the betas derived from the CAPM and as explanatory variables the E, S and G scores (Equation 13)

Dependent Variable: BETA_CAPM
Method: Least Squares
Date: 04/01/19 Time: 11:20
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.485204	0.202672	7.328121	0.0000
E_SCORES	0.006325	0.001990	3.178285	0.0017
S_SCORES	-0.000473	0.002478	-0.190813	0.8489
G_SCORES	-0.015004	0.003132	-4.790423	0.0000

R-squared	0.130394	Mean dependent var	0.918637
Adjusted R-squared	0.117084	S.D. dependent var	0.340162
S.E. of regression	0.319628	Akaike info criterion	0.576480
Sum squared resid	20.02378	Schwarz criterion	0.642446
Log likelihood	-53.64801	Hannan-Quinn criter.	0.603176
F-statistic	9.796500	Durbin-Watson stat	1.887353
Prob(F-statistic)	0.000005		

Cross-sectional regression having as a dependent variable the betas derived from the Fama-French three factors model and as an explanatory variable the ESG scores (Equation 9)

Dependent Variable: BETA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:29
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.899333	0.171119	5.255600	0.0000
ESG_SCORES	0.000492	0.002758	0.178340	0.8586

R-squared	0.000161	Mean dependent var	0.929585
Adjusted R-squared	-0.004889	S.D. dependent var	0.317818
S.E. of regression	0.318594	Akaike info criterion	0.560150
Sum squared resid	20.09739	Schwarz criterion	0.593133
Log likelihood	-54.01497	Hannan-Quinn criter.	0.573497
F-statistic	0.031805	Durbin-Watson stat	1.893102
Prob(F-statistic)	0.858638		

Cross sectional regression having as a dependent variable the betas derived from the Fama-French three factor model and as an explanatory variable the E scores (Equation 10)

Dependent Variable: BETA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:29
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.735361	0.114195	6.439497	0.0000
E_SCORES	0.003024	0.001743	1.734386	0.0844

R-squared	0.014965	Mean dependent var	0.929585
Adjusted R-squared	0.009990	S.D. dependent var	0.317818
S.E. of regression	0.316226	Akaike info criterion	0.545232
Sum squared resid	19.79981	Schwarz criterion	0.578215
Log likelihood	-52.52322	Hannan-Quinn criter.	0.558580
F-statistic	3.008095	Durbin-Watson stat	1.914409
Prob(F-statistic)	0.084406		

Cross-sectional regression having as a dependent variable the betas derived from the Fama-French three factor model and as an explanatory variable the S scores (Equation 11)

Dependent Variable: BETA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:30
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.897928	0.128832	6.969781	0.0000
S_SCORES	0.000534	0.002142	0.249568	0.8032

R-squared	0.000314	Mean dependent var	0.929585
Adjusted R-squared	-0.004734	S.D. dependent var	0.317818
S.E. of regression	0.318569	Akaike info criterion	0.559996
Sum squared resid	20.09430	Schwarz criterion	0.592979
Log likelihood	-53.99958	Hannan-Quinn criter.	0.573344
F-statistic	0.062284	Durbin-Watson stat	1.893950
Prob(F-statistic)	0.803180		

Cross-sectional regression having as a dependent variable the betas derived from the Fama-French three factor model and as an explanatory variable the G scores (Equation 12)

Dependent Variable: BETA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:31
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.702010	0.176458	9.645433	0.0000
G_SCORES	-0.012266	0.002781	-4.410251	0.0000

R-squared	0.089447	Mean dependent var	0.929585
Adjusted R-squared	0.084848	S.D. dependent var	0.317818
S.E. of regression	0.304036	Akaike info criterion	0.466607
Sum squared resid	18.30268	Schwarz criterion	0.499590
Log likelihood	-44.66070	Hannan-Quinn criter.	0.479955
F-statistic	19.45031	Durbin-Watson stat	1.863377
Prob(F-statistic)	0.000017		

Cross-sectional regressions having as a dependent variable the betas derived from the Fama-French three factor model and as explanatory variables the E, S and G scores (Equation 13)

Dependent Variable: BETA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:31
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.476683	0.188765	7.822865	0.0000
E_SCORES	0.004915	0.001854	2.651266	0.0087
S_SCORES	0.001559	0.002308	0.675450	0.5002
G_SCORES	-0.015167	0.002917	-5.199039	0.0000

R-squared	0.135843	Mean dependent var	0.929585
Adjusted R-squared	0.122616	S.D. dependent var	0.317818
S.E. of regression	0.297696	Akaike info criterion	0.434309
Sum squared resid	17.37009	Schwarz criterion	0.500276
Log likelihood	-39.43093	Hannan-Quinn criter.	0.461005
F-statistic	10.27022	Durbin-Watson stat	1.896108
Prob(F-statistic)	0.000003		

Appendix 7: Tables of the cross-sectional regressions having as a dependent variable the risk-adjusted returns and, as an independent variable, the sustainable data

Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as an explanatory variable the ESG scores (Equation 14)

Dependent Variable: ALPHA_CAPM
Method: Least Squares
Date: 03/31/19 Time: 21:53
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.072076	0.044233	1.629445	0.1048
ESG_SCORES	-0.001176	0.000713	-1.649814	0.1006

R-squared	0.013560	Mean dependent var	-0.000266
Adjusted R-squared	0.008578	S.D. dependent var	0.082710
S.E. of regression	0.082355	Akaike info criterion	-2.145608
Sum squared resid	1.342901	Schwarz criterion	-2.112625
Log likelihood	216.5608	Hannan-Quinn criter.	-2.132260
F-statistic	2.721885	Durbin-Watson stat	1.880691
Prob(F-statistic)	0.100567		

Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as an explanatory variable the E scores (Equation 15)

Dependent Variable: ALPHA_CAPM
Method: Least Squares
Date: 03/31/19 Time: 21:55
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.014124	0.029925	0.471984	0.6375
E_SCORES	-0.000224	0.000457	-0.490359	0.6244

R-squared	0.001213	Mean dependent var	-0.000266
Adjusted R-squared	-0.003831	S.D. dependent var	0.082710
S.E. of regression	0.082869	Akaike info criterion	-2.133168
Sum squared resid	1.359711	Schwarz criterion	-2.100185
Log likelihood	215.3168	Hannan-Quinn criter.	-2.119821
F-statistic	0.240452	Durbin-Watson stat	1.892086
Prob(F-statistic)	0.624423		

Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as an explanatory variable the S scores (Equation 16)

Dependent Variable: ALPHA_CAPM
Method: Least Squares
Date: 03/31/19 Time: 21:58
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.064198	0.033209	1.933181	0.0546
S_SCORES	-0.001088	0.000552	-1.971556	0.0501

R-squared	0.019254	Mean dependent var	-0.000266
Adjusted R-squared	0.014300	S.D. dependent var	0.082710
S.E. of regression	0.082117	Akaike info criterion	-2.151396
Sum squared resid	1.335151	Schwarz criterion	-2.118413
Log likelihood	217.1396	Hannan-Quinn criter.	-2.138048
F-statistic	3.887034	Durbin-Watson stat	1.906166
Prob(F-statistic)	0.050053		

Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as an explanatory variable the G scores (Equation 17)

Dependent Variable: ALPHA_CAPM
Method: Least Squares
Date: 03/31/19 Time: 22:00
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.053683	0.047970	1.119107	0.2645
G_SCORES	-0.000857	0.000756	-1.133089	0.2585

R-squared	0.006443	Mean dependent var	-0.000266
Adjusted R-squared	0.001425	S.D. dependent var	0.082710
S.E. of regression	0.082651	Akaike info criterion	-2.138418
Sum squared resid	1.352591	Schwarz criterion	-2.105435
Log likelihood	215.8418	Hannan-Quinn criter.	-2.125070
F-statistic	1.283891	Durbin-Watson stat	1.916304
Prob(F-statistic)	0.258547		

Cross-sectional regression having as a dependent variable the alphas derived from the CAPM and as explanatory variables the E, S and G scores (Equation 18)

Dependent Variable: ALPHA_CAPM
Method: Least Squares
Date: 03/31/19 Time: 22:01
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.078603	0.052265	1.503950	0.1342
E_SCORES	0.000261	0.000513	0.508720	0.6115
S_SCORES	-0.001116	0.000639	-1.746791	0.0822
G_SCORES	-0.000469	0.000808	-0.580556	0.5622

R-squared	0.021858	Mean dependent var	-0.000266
Adjusted R-squared	0.006887	S.D. dependent var	0.082710
S.E. of regression	0.082425	Akaike info criterion	-2.134055
Sum squared resid	1.331605	Schwarz criterion	-2.068089
Log likelihood	217.4055	Hannan-Quinn criter.	-2.107360
F-statistic	1.459972	Durbin-Watson stat	1.929716
Prob(F-statistic)	0.226757		

Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three factor model and as an explanatory variable the ESG scores (Equation 14)

Dependent Variable: ALPHA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:08
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.073680	0.038274	1.925085	0.0557
ESG_SCORES	-0.001175	0.000617	-1.905338	0.0582

R-squared	0.018005	Mean dependent var	0.001391
Adjusted R-squared	0.013045	S.D. dependent var	0.071728
S.E. of regression	0.071259	Akaike info criterion	-2.435044
Sum squared resid	1.005411	Schwarz criterion	-2.402061
Log likelihood	245.5044	Hannan-Quinn criter.	-2.421697
F-statistic	3.630314	Durbin-Watson stat	1.941346
Prob(F-statistic)	0.058185		

Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three factor model and as an explanatory variable the E scores (Equation 15)

Dependent Variable: ALPHA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:09
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.029037	0.025890	1.121539	0.2634
E_SCORES	-0.000430	0.000395	-1.088911	0.2775

R-squared	0.005953	Mean dependent var	0.001391
Adjusted R-squared	0.000932	S.D. dependent var	0.071728
S.E. of regression	0.071695	Akaike info criterion	-2.422846
Sum squared resid	1.017750	Schwarz criterion	-2.389863
Log likelihood	244.2846	Hannan-Quinn criter.	-2.409498
F-statistic	1.185726	Durbin-Watson stat	1.940536
Prob(F-statistic)	0.277517		

Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three factor model and as an explanatory variable the S scores (Equation 16)

Dependent Variable: ALPHA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:10
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.048921	0.028878	1.694069	0.0918
S_SCORES	-0.000802	0.000480	-1.671669	0.0962

R-squared	0.013917	Mean dependent var	0.001391
Adjusted R-squared	0.008937	S.D. dependent var	0.071728
S.E. of regression	0.071407	Akaike info criterion	-2.430890
Sum squared resid	1.009596	Schwarz criterion	-2.397907
Log likelihood	245.0890	Hannan-Quinn criter.	-2.417543
F-statistic	2.794477	Durbin-Watson stat	1.979347
Prob(F-statistic)	0.096169		

Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three factor model and as an explanatory variable the G scores (Equation 17)

Dependent Variable: ALPHA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:11
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.054525	0.041561	1.311925	0.1911
G_SCORES	-0.000844	0.000655	-1.288063	0.1992

R-squared	0.008310	Mean dependent var	0.001391
Adjusted R-squared	0.003301	S.D. dependent var	0.071728
S.E. of regression	0.071610	Akaike info criterion	-2.425220
Sum squared resid	1.015337	Schwarz criterion	-2.392237
Log likelihood	244.5220	Hannan-Quinn criter.	-2.411872
F-statistic	1.659107	Durbin-Watson stat	1.984899
Prob(F-statistic)	0.199227		

Cross-sectional regression having as a dependent variable the alphas derived from the Fama-French three factor model and as explanatory variables the E, S and G scores (Equation 18)

Dependent Variable: ALPHA_FF
Method: Least Squares
Date: 04/01/19 Time: 11:12
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.077754	0.045430	1.711528	0.0886
E_SCORES	-0.000124	0.000446	-0.277188	0.7819
S_SCORES	-0.000610	0.000555	-1.098113	0.2735
G_SCORES	-0.000513	0.000702	-0.730452	0.4660

R-squared	0.017339	Mean dependent var	0.001391
Adjusted R-squared	0.002298	S.D. dependent var	0.071728
S.E. of regression	0.071646	Akaike info criterion	-2.414366
Sum squared resid	1.006093	Schwarz criterion	-2.348400
Log likelihood	245.4366	Hannan-Quinn criter.	-2.387671
F-statistic	1.152779	Durbin-Watson stat	1.968854
Prob(F-statistic)	0.329039		

Appendix 8: Example of the Fama-French four-factor time-series regressions' results obtained for a given company (Abbott Laboratories)

ESG fourth factor (Equation 19)

Dependent Variable: EXCESS_RET_AL
Method: Least Squares
Date: 03/22/19 Time: 22:05
Sample: 1 251
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.098932	0.052455	1.886041	0.0605
RM_RF__251_OBSERVATIONS_	0.999456	0.052092	19.18638	0.0000
SMB__251_OBSERVATIONS_	-0.311213	0.102455	-3.037554	0.0026
HML__251_OBSERVATIONS_	-0.237267	0.103347	-2.295828	0.0225
ESG_FACTOR__251_OBSERVATIONS	0.143931	0.109638	1.312791	0.1905

R-squared	0.665479	Mean dependent var	0.097335
Adjusted R-squared	0.660040	S.D. dependent var	1.413482
S.E. of regression	0.824146	Akaike info criterion	2.470782
Sum squared resid	167.0875	Schwarz criterion	2.541010
Log likelihood	-305.0832	Hannan-Quinn criter.	2.499044
F-statistic	122.3450	Durbin-Watson stat	1.833391
Prob(F-statistic)	0.000000		

E fourth factor (Equation 20)

Dependent Variable: EXCESS_RET_ABBOTT
Method: Least Squares
Date: 05/20/19 Time: 17:56
Sample: 1 251
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.106540	0.052660	2.023165	0.0441
RM_RF__251_OBSERVATIONS_	0.983289	0.054402	18.07454	0.0000
SMB_251_OBSERVATIONS	-0.290889	0.104506	-2.783473	0.0058
HML__251_OBSERVATIONS_	-0.270101	0.104383	-2.587607	0.0102
E_FACTOR__251_OBERVATIONS_	-0.061178	0.121447	-0.503740	0.6149

R-squared	0.663483	Mean dependent var	0.097335
Adjusted R-squared	0.658011	S.D. dependent var	1.413482
S.E. of regression	0.826602	Akaike info criterion	2.476732
Sum squared resid	168.0846	Schwarz criterion	2.546961
Log likelihood	-305.8299	Hannan-Quinn criter.	2.504994
F-statistic	121.2543	Durbin-Watson stat	1.825890
Prob(F-statistic)	0.000000		

S fourth factor (Equation 21)

Dependent Variable: EXCESS_RET_ABBOTT
Method: Least Squares
Date: 05/20/19 Time: 17:57
Sample: 1 251
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.097383	0.052198	1.865660	0.0633
RM_RF__251_OBSERVATIONS_	0.976083	0.052124	18.72624	0.0000
SMB__251_OBSERVATIONS_	-0.311604	0.101881	-3.058507	0.0025
HML__251_OBSERVATIONS_	-0.201556	0.105765	-1.905700	0.0579
S_FACTOR__251_OBSERVATIONS	0.194931	0.099761	1.953982	0.0518

R-squared	0.668284	Mean dependent var	0.097335
Adjusted R-squared	0.662890	S.D. dependent var	1.413482
S.E. of regression	0.820684	Akaike info criterion	2.462362
Sum squared resid	165.6865	Schwarz criterion	2.532590
Log likelihood	-304.0265	Hannan-Quinn criter.	2.490624
F-statistic	123.8995	Durbin-Watson stat	1.845647
Prob(F-statistic)	0.000000		

G fourth factor (Equation 22)

Dependent Variable: EXCESS_RET_ABBOTT
Method: Least Squares
Date: 05/20/19 Time: 17:57
Sample: 1 251
Included observations: 251

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.101434	0.052421	1.934973	0.0541
RM_RF__251_OBSERVATIONS_	0.946885	0.066188	14.30610	0.0000
SMB__251_OBSERVATIONS_	-0.318179	0.103478	-3.074858	0.0023
HML__251_OBSERVATIONS_	-0.241487	0.103410	-2.335227	0.0203
G_FACTOR__251_OBSERVATIONS_	0.093890	0.086687	1.083095	0.2798

R-squared	0.664734	Mean dependent var	0.097335
Adjusted R-squared	0.659283	S.D. dependent var	1.413482
S.E. of regression	0.825063	Akaike info criterion	2.473006
Sum squared resid	167.4595	Schwarz criterion	2.543234
Log likelihood	-305.3623	Hannan-Quinn criter.	2.501268
F-statistic	121.9366	Durbin-Watson stat	1.832314
Prob(F-statistic)	0.000000		

Appendix 9: Tables of the cross-sectional regressions having as a dependent variable the average annual returns for the year 2018 and, as independent variables, the estimated market factor, SMB factor, HML factor and sustainable factor

Cross-sectional regression having as a dependent variable the Ri 2018 and as explanatory variables the estimated betas related to Rm-Rf, SMB, HML and ESG (Equation 23)

Dependent Variable: AVERAGE_ANNUAL_RETURNS
Method: Least Squares
Date: 04/01/19 Time: 13:41
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.005062	0.017356	-0.291660	0.7709
BETA_RELATED_TO_RM_RF	-0.004689	0.016751	-0.279933	0.7798
BETA_RELATED_TO_SMB	-0.028861	0.021092	-1.368343	0.1728
BETA_RELATED_TO_HML	-0.067131	0.008368	-8.022654	0.0000
BETA_RELATED_TO_ESG	0.057837	0.011552	5.006473	0.0000

R-squared	0.336920	Mean dependent var	-0.013217
Adjusted R-squared	0.323318	S.D. dependent var	0.079354
S.E. of regression	0.065277	Akaike info criterion	-2.595666
Sum squared resid	0.830917	Schwarz criterion	-2.513208
Log likelihood	264.5666	Hannan-Quinn criter.	-2.562296
F-statistic	24.77051	Durbin-Watson stat	2.087483
Prob(F-statistic)	0.000000		

Cross-sectional regression having as a dependent variable the Ri 2018 and as explanatory variables the estimated betas related to Rm-Rf, SMB, HML and ESG (Equation 24)

Dependent Variable: RI 2018
Method: Least Squares
Date: 05/23/19 Time: 10:34
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.026341	0.019342	-1.361841	0.1748
RM_RF_E_FACTOR	0.009712	0.018216	0.533157	0.5945
SMB_E_FACTOR	-0.046246	0.022142	-2.088630	0.0380
HML_E_FACTOR	-0.067065	0.008515	-7.875726	0.0000
E FACTOR	0.046097	0.012114	3.805235	0.0002

R-squared	0.315628	Mean dependent var	-0.013217
Adjusted R-squared	0.301590	S.D. dependent var	0.079354
S.E. of regression	0.066317	Akaike info criterion	-2.564061
Sum squared resid	0.857597	Schwarz criterion	-2.481603
Log likelihood	261.4061	Hannan-Quinn criter.	-2.530691
F-statistic	22.48322	Durbin-Watson stat	2.022980
Prob(F-statistic)	0.000000		

Cross-sectional regression having as a dependent variable the Ri 2018 and as explanatory variables the estimated betas related to Rm-Rf, SMB, HML and ESG (Equation 25)

Dependent Variable: RI 2018
Method: Least Squares
Date: 05/23/19 Time: 10:36
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010910	0.017521	0.622715	0.5342
RM_RF_S	-0.022650	0.016831	-1.345699	0.1800
SMB_S	-0.024571	0.021185	-1.159825	0.2475
HML_S_FACTOR	-0.068238	0.008409	-8.114814	0.0000
S FACTOR	0.063062	0.012189	5.173739	0.0000

R-squared	0.330875	Mean dependent var	-0.013217
Adjusted R-squared	0.317150	S.D. dependent var	0.079354
S.E. of regression	0.065574	Akaike info criterion	-2.586591
Sum squared resid	0.838491	Schwarz criterion	-2.504133
Log likelihood	263.6591	Hannan-Quinn criter.	-2.553222
F-statistic	24.10637	Durbin-Watson stat	2.069499
Prob(F-statistic)	0.000000		

Cross-sectional regression having as a dependent variable the Ri 2018 and as explanatory variables the estimated betas related to Rm-Rf, SMB, HML and ESG (Equation 26)

Dependent Variable: RI 2018
Method: Least Squares
Date: 05/23/19 Time: 10:37
Sample: 1 200
Included observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.037827	0.025250	1.498090	0.1357
RM_RF_G_FACTOR	-0.050232	0.024792	-2.026111	0.0441
SMB_G_FACTOR	-0.030721	0.021896	-1.403051	0.1622
HML_G_FACTOR	-0.068093	0.008678	-7.846729	0.0000
G FACTOR	0.019953	0.011386	1.752373	0.0813

R-squared	0.289768	Mean dependent var	-0.013217
Adjusted R-squared	0.275200	S.D. dependent var	0.079354
S.E. of regression	0.067558	Akaike info criterion	-2.526971
Sum squared resid	0.890003	Schwarz criterion	-2.444513
Log likelihood	257.6971	Hannan-Quinn criter.	-2.493601
F-statistic	19.88958	Durbin-Watson stat	2.039416
Prob(F-statistic)	0.000000		

Appendix 10: Correlation tables related to estimated risk factors used in equations 23, 24, 25 and 26

Correlation table 31 included my estimated ESG risk factor

	$\widehat{ß}_{im}$	$\widehat{ß}_{is}$	$\widehat{ß}_{ih}$	$\widehat{ß}_{iESG}$
$\widehat{ß}_{im}$	1			
$\widehat{ß}_{is}$	0.46280899	1		
$\widehat{ß}_{ih}$	-0.0732366	0.14027362	1	
$\widehat{ß}_{iESG}$	-0.0574221	-0.1656666	0.04619515	1

Correlation table 32 included my estimated E risk factor

	$\widehat{ß}_{im}$	$\widehat{ß}_{is}$	$\widehat{ß}_{ih}$	$\widehat{ß}_{iE}$
$\widehat{ß}_{im}$	1			
$\widehat{ß}_{is}$	0.51700397	1		
$\widehat{ß}_{ih}$	-0.08330535	0.13190774	1	
$\widehat{ß}_{iE}$	-0.1287271	-0.1964914	0.09927958	1

Correlation table 33 included my estimated S risk factor

	$\widehat{ß}_{im}$	$\widehat{ß}_{is}$	$\widehat{ß}_{ih}$	$\widehat{ß}_{iS}$
$\widehat{ß}_{im}$	1			
$\widehat{ß}_{is}$	0.46172666	1		
$\widehat{ß}_{ih}$	-0.0580056	0.14159318	1	
$\widehat{ß}_{iS}$	0.02711767	-0.0648115	0.10027612	1

Correlation table 34 included my estimated G risk factor

	$\widehat{ß}_{im}$	$\widehat{ß}_{is}$	$\widehat{ß}_{ih}$	$\widehat{ß}_{iG}$
$\widehat{ß}_{im}$	1			
$\widehat{ß}_{is}$	0.28475515	1		
$\widehat{ß}_{ih}$	0.03480685	0.21382246	1	
$\widehat{ß}_{iG}$	0.20391491	0.09305277	0.04464959	1